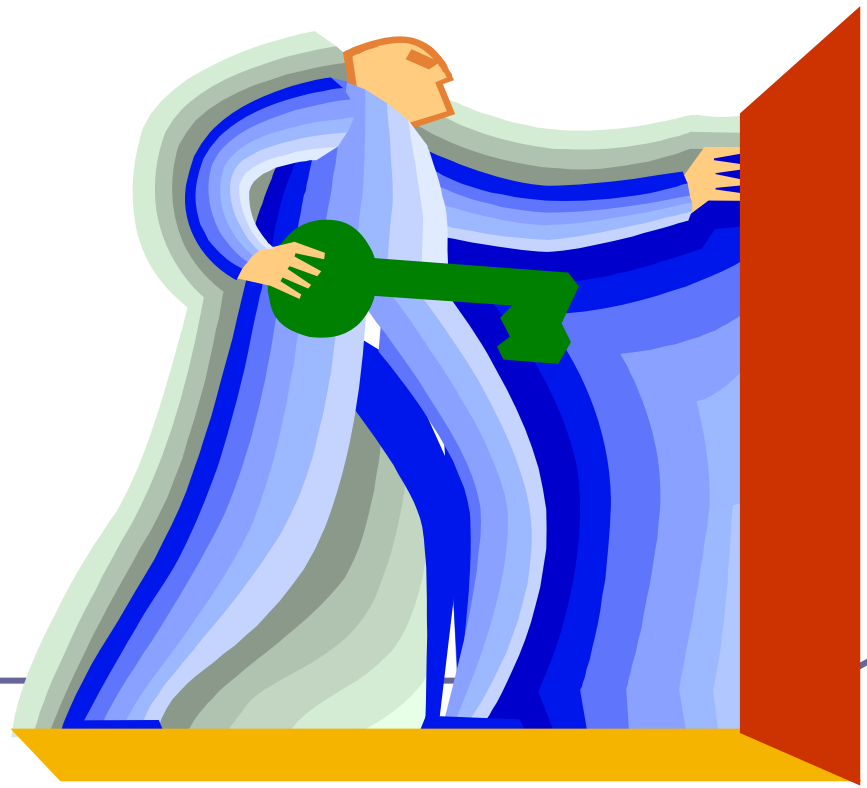
Applying Advanced Asset Management Principles To Sustain Water Infrastructure.

USEPA
Advanced Asset Management

Steve Allbee
USEPA



This Presentation

- **An overview of trends and strategies in the provision of water and wastewater services.**
- **Establishing common quantitative understanding of the magnitude of required investment.**
- **Aging systems.**
- **A brief overview of USEPA Training on Advanced Asset Management.**
- **A strategic level glance at lessons learned in asset management processes, practices, tools and techniques.**
- **What's new!**

A Brief Overview of Water and Wastewater Infrastructure

Part of the fabric of modern living -- along with roads, transportation systems, energy and communications networks and other similar systems needed to deliver services

Water Related Infrastructure

- **Generally very large.**
- **The costs are usually “sunk”.**
- **Asset lives are long.**
- **The services are often major inputs into a wide range of other industries and activities.**
- **Frequently substantially impacted by other types of infrastructure decisions, especially choices about land use and the density of urban development.**

The Characteristics of Water Infrastructure Assets

- **The systems are maintained in perpetuity.**
- **Large networks are made up of components that are replaced, but network service potential remains constant.**
- **Don’t actually (physically) depreciate on a straight line basis - that is, loss of service potential is not evenly distributed across time.**

The Financial Objectives Regarding Water Infrastructure

- **Investment adequate to replace the existing systems and acquire new service necessary to meet public heath, environmental and service objectives.**
- **The most efficient and effective utilization of capital and non-capital spending.**
- **Systems where affordability does not impede achieving objectives.**
- **Systems that are sustainable.**

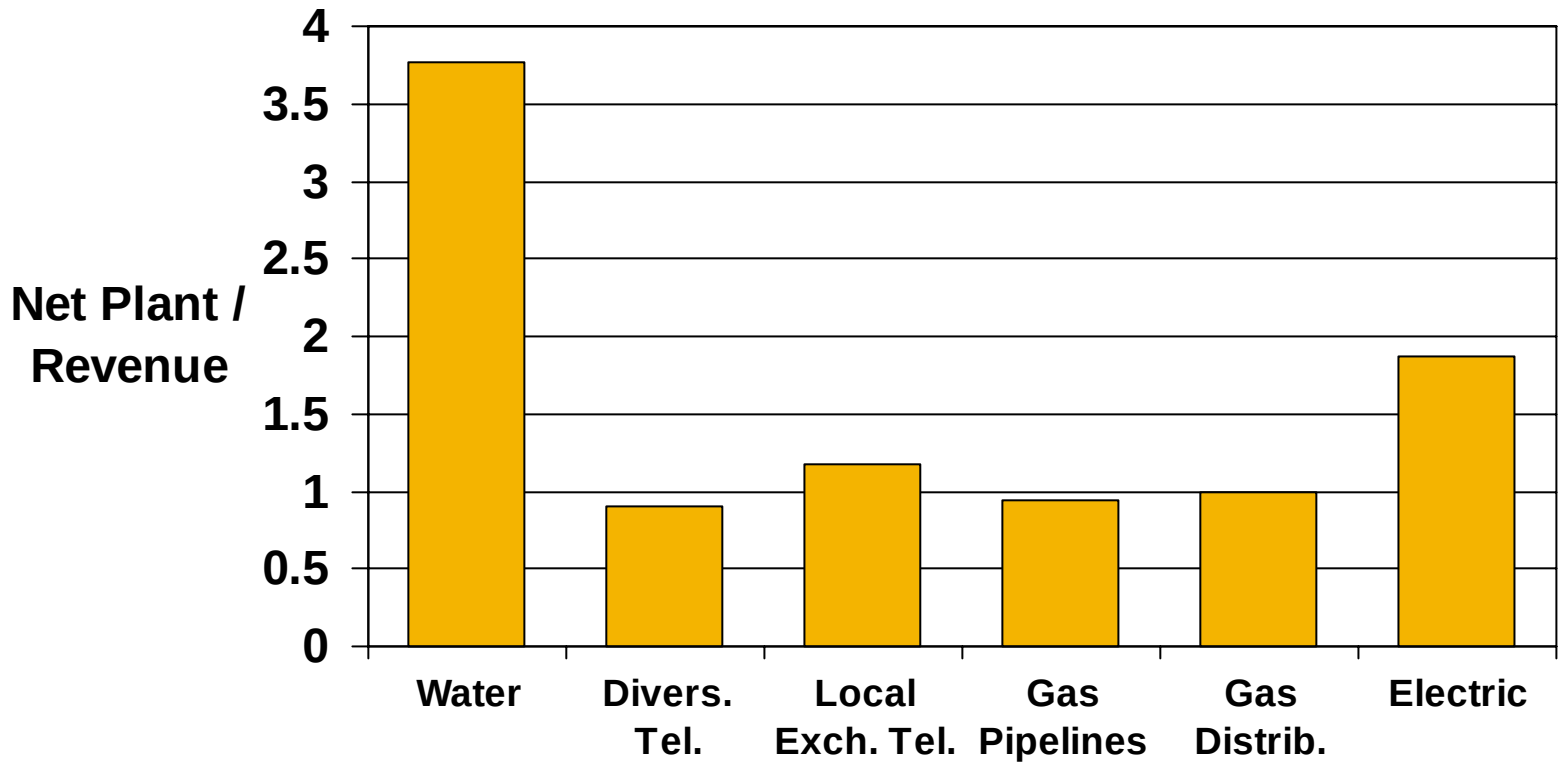
The Anticipated Performance Expectations

- **Meet level of service requirements.**
- **Reduce the impact (foot print) on the environment.**
- **Generate funds to build and rebuild systems.**
- **Efficiently use existing capacity.**
- **Promote efficient urban growth.**
- **Reflect optimal decision-making by adopting least life cycle costs approaches to meet current and future service requirements.**
- **User pay principles, but keep charges affordable.**

We Have Highly Decentralize Management Of Water / Wastewater Assets

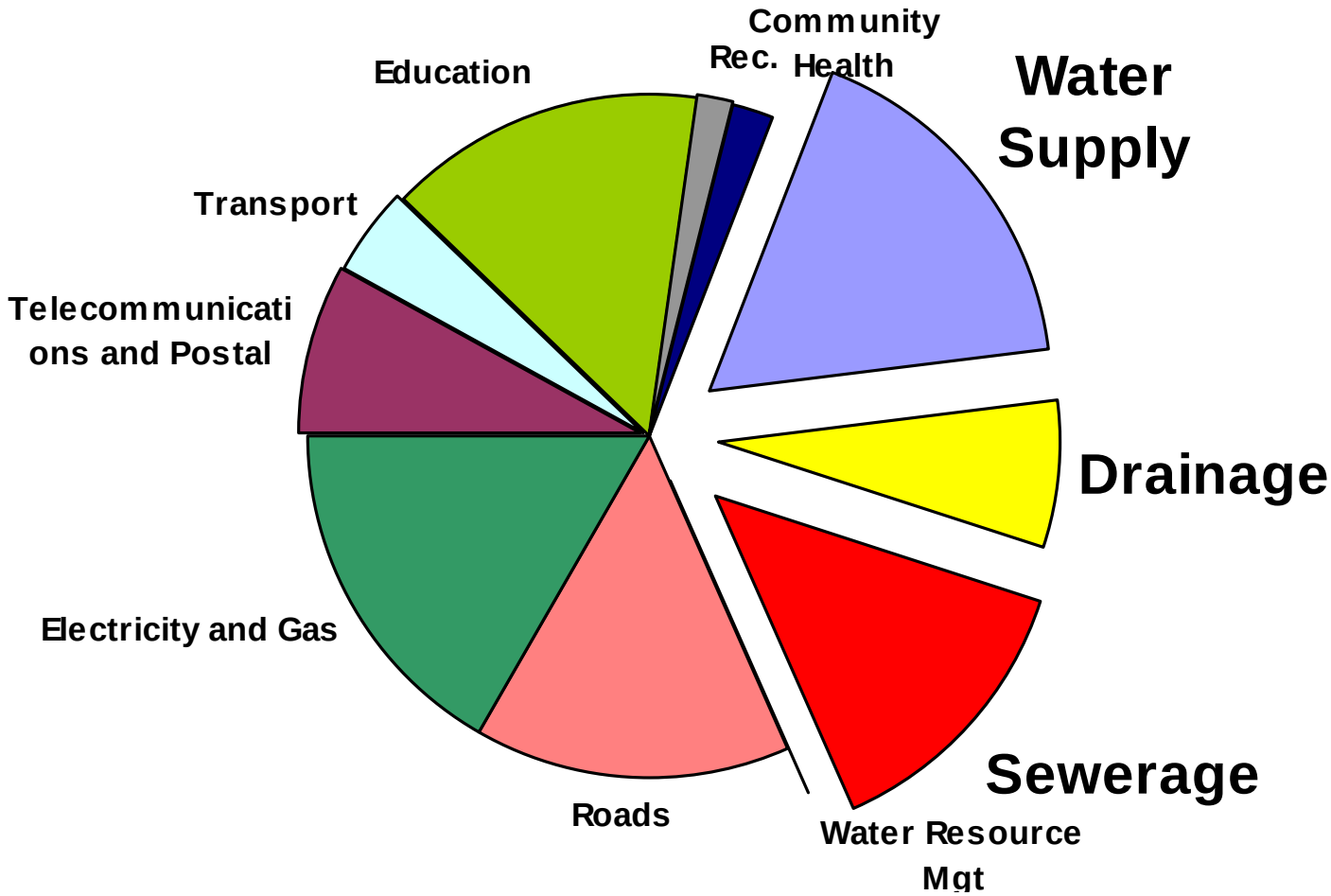
- There are 16,000 public owned wastewater systems serving 75% of the population through centralized systems
- There are 54,000 community based water systems serving about 94% of the population through centralized systems
- The remainder of the population is served by on-site systems and private wells
- Most of the systems are small or very small
- However, most of the population is served by a relatively few large systems

Water and Wastewater Systems Are Highly Capital Intensive - - The Networks (distribution and collection) Are Costly - -



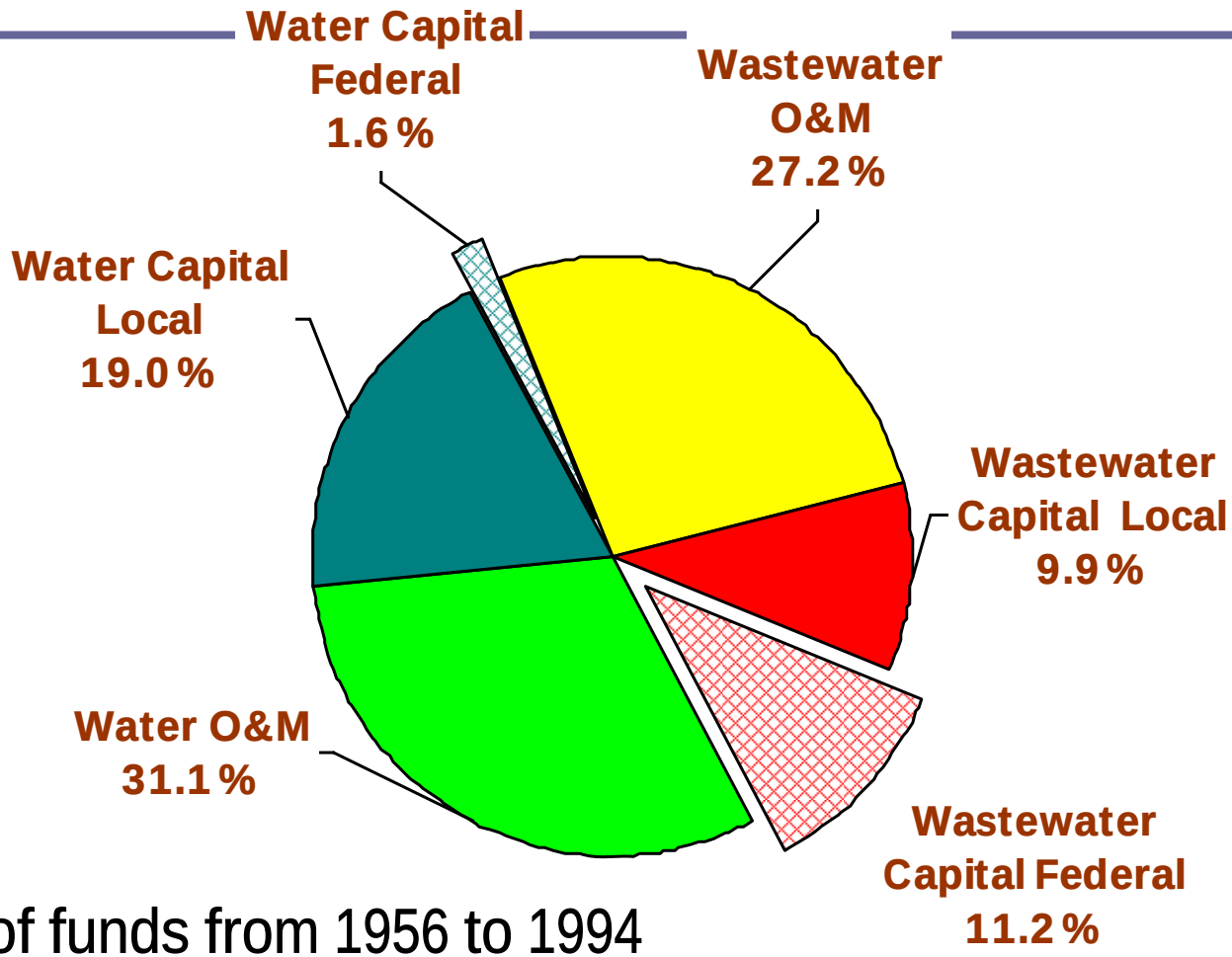
Purvenas, T.J., "Infrastructure Replacement – Credit Quality Concerns," *Water,* Spring 1998, National Association of Water Companies, Washington, D.C.

Water, Sewerage and Drainage (30 to 35%) of All Capital Investment in Infrastructure Associated With An Urban Lot



An Australian study on the relative capital costs of all forms of infrastructure investment to serve a typical lot in Melbourne.

The Vast Majority of the Resources Comes From Local Sources



Sources of funds from 1956 to 1994

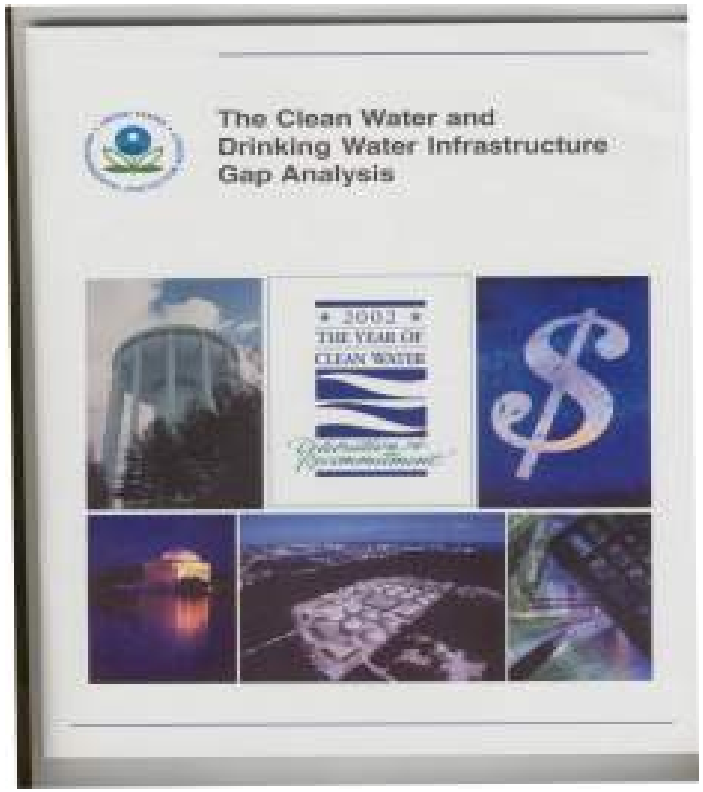
The USEPA Undertook A Gap Analysis To Establish a Common Understanding of The Challenges Ahead

The Understanding:

- Does not predict fate - - it identifies the challenge.
- Once it is determined where you are, you can do something about getting somewhere else.
- Identifying the elements of the challenge allows resources to be used where it counts most.
- Early understanding provides time to take steps to mitigate adverse outcomes and reach consensus on a pathway forward.

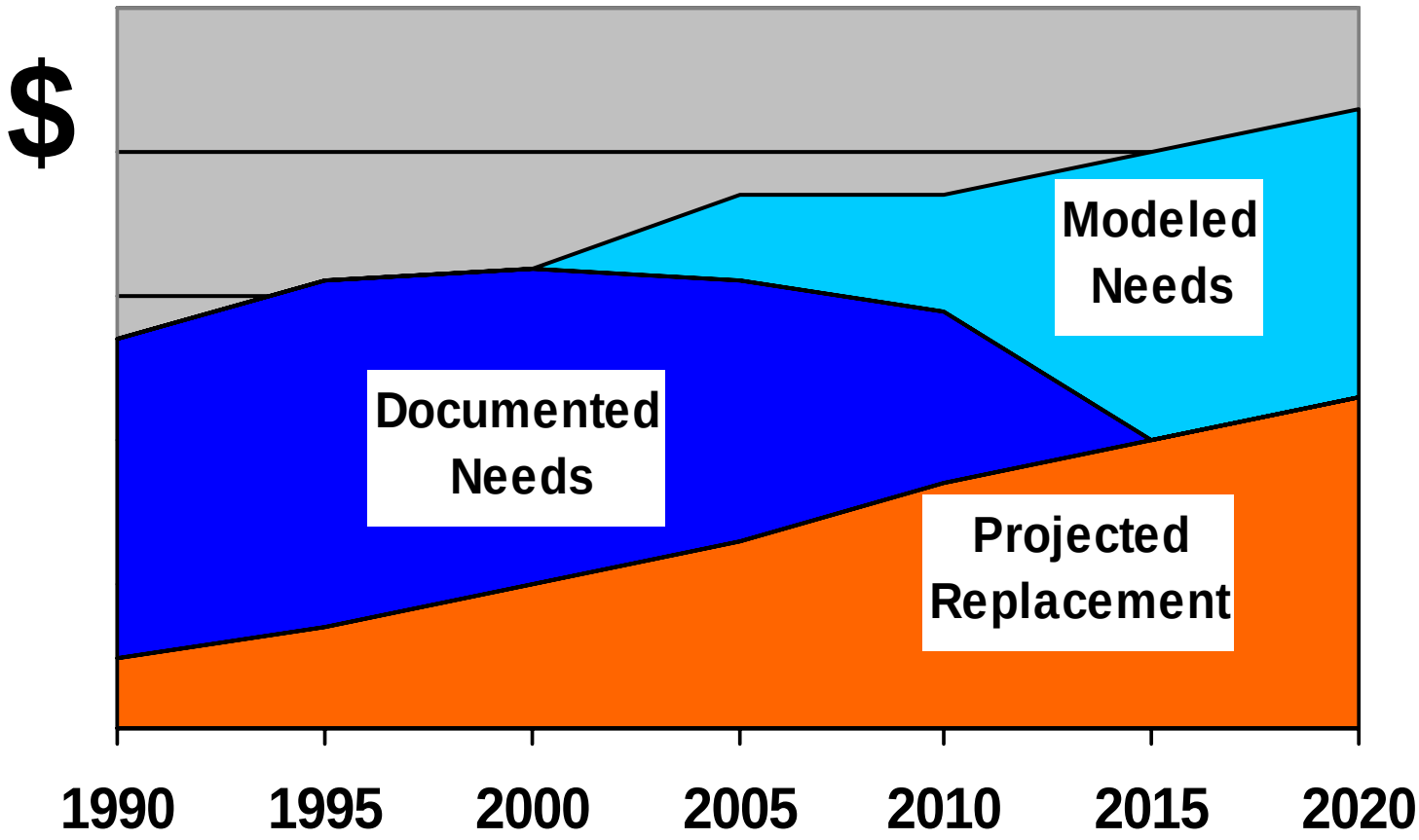
The Gap Report Is Intended to Provide - - A Transparent Starting Point - - The Gap Report Was Released - - WEFTEC 2002

- **Purpose -- To reach a common quantitative understanding of the potential magnitude of investment needed to:**
  - **Address growing population and economic needs, and**
  - **Renew our existing aging infrastructure.**
- **The data is comparable, at order of magnitude level, with WIN & CBO reports.**



http://www.epa.gov/owm/gapreport.pdf

The Source of Estimates



The Findings (2000-2019)

No Revenue Growth Scenario

Total Payment Gap (20 Years) (Average in Billions of Dollars)		
	Clean Water	Drinking Water
Capital	$122	$102
O&M	$148	$161
Total	$271	$263

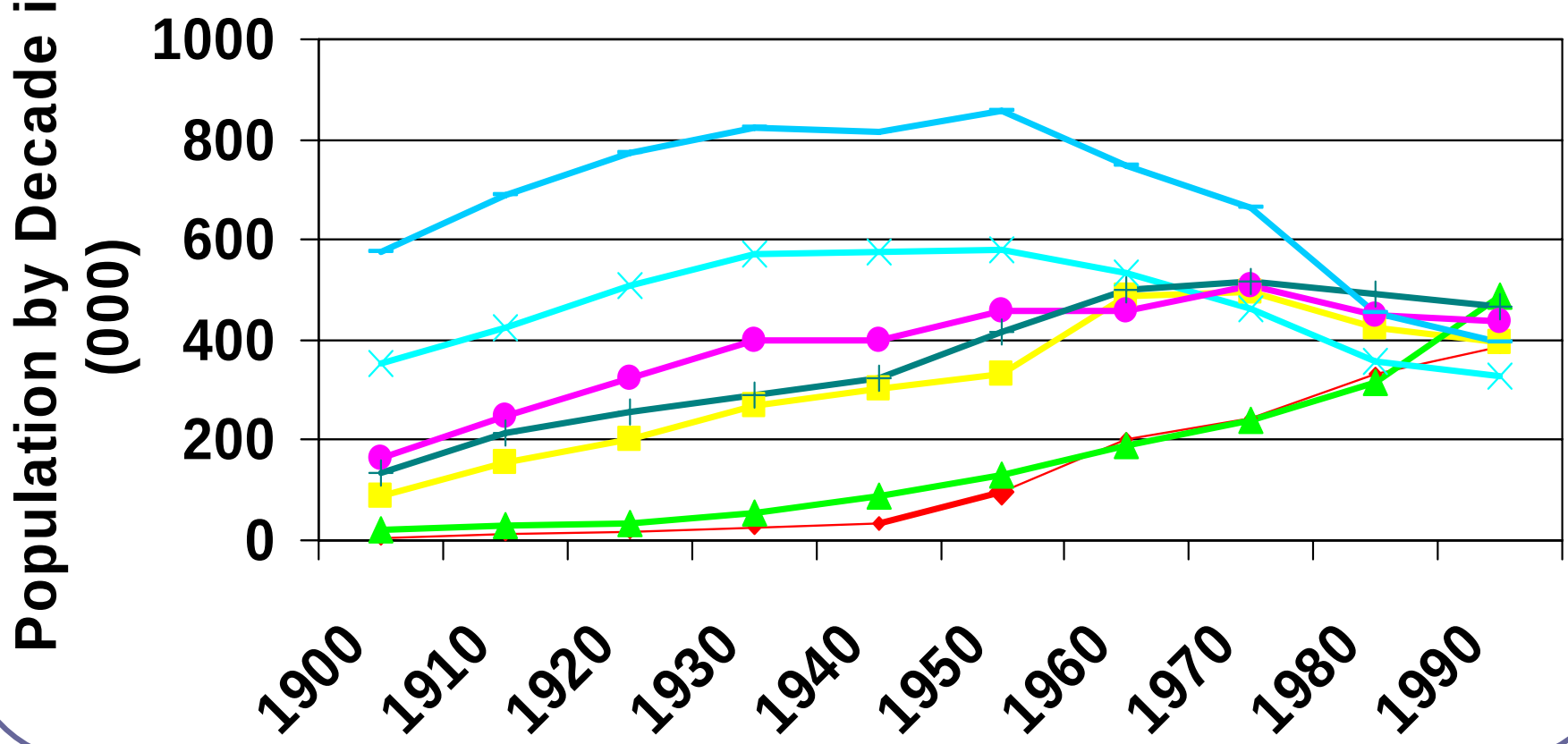
Revenue Growth Scenario

Total Payment Gap (20 Years) (Average in Billions of Dollars)		
	Clean Water	Drinking Water
Capital	$21	$45
O&M	$10	$0
Total	$31	$45

(Annual Rate of Increase - 3% Real)

The Estimates Represent National Aggregate Numbers- The Projection Techniques Cannot Be Rationally Disaggregated To Apply To A Specific Area.

Seven Metropolitan Regions That Currently Have Simliar Service Populations



There Are Other Reports That Suggest Growing Awareness Concerning The Challenge of Aging Infrastructure From Multiple Viewpoints

THE U.S. CONFERENCE OF MAYORS

URBAN WATER COUNCIL

The National City Water Survey 2005

The *NATIONAL CITY WATER SURVEY* was distributed to nearly 1,200 cities with mayoral forms of government (Populations of 30,000 or greater). Nearly 35 percent of the principal cities (414 cities) responded to the survey

At the top of the priorities identified, a combination of chronic "every-day" problems associated with maintaining and rehabilitating aging water and wastewater infrastructure

Source: National City Water Survey, 2005

NATIONAL CITY WATER SURVEY 2005

Sort by Population Size	% of Cities
Smaller Cities Less Than 50,000	41
Medium Cities 50,000 to 100,000	34
Large Cities Greater Than 100,000	25

The Respondents Were Relatively Large Cities

Source: National City Water Survey, 2005

Rank Order	Water Resources Issue National City Water Survey 2005	Percent Of Cities
1	Aging Water Infrastructure	60.6
2	Security/Protection of Water Infrastructure	54.6
3	Water Supply Availability	46.4
4	Permits, Regulatory Issues	45.2
5	Water Quality/Urban Streams-Rivers	42.3
6	Flooding	38.4
7	Emergency Planning and Management: storms, hurricanes	34.3
8	Drought Management	32.6
9	Regional Conflict Over Water Use	26.8
10	Water Rights	25.1

Source: National City Water Survey, 2005

NATIONAL CITY WATER SURVEY 2005

*Actual Investment

** Planned Investment

Infrastructure	2000 – 2004* (% of cities)	2005 – 2009** (% of cities)
Water Supply	61.5	59.3
Water Treatment Plant	56.5	49.6
Water Distribution System	83.7	79.0
Wastewater Treatment Plant	55.5	52.8
Wastewater Collection System	72.2	69.8

Source: National City Water Survey, 2005

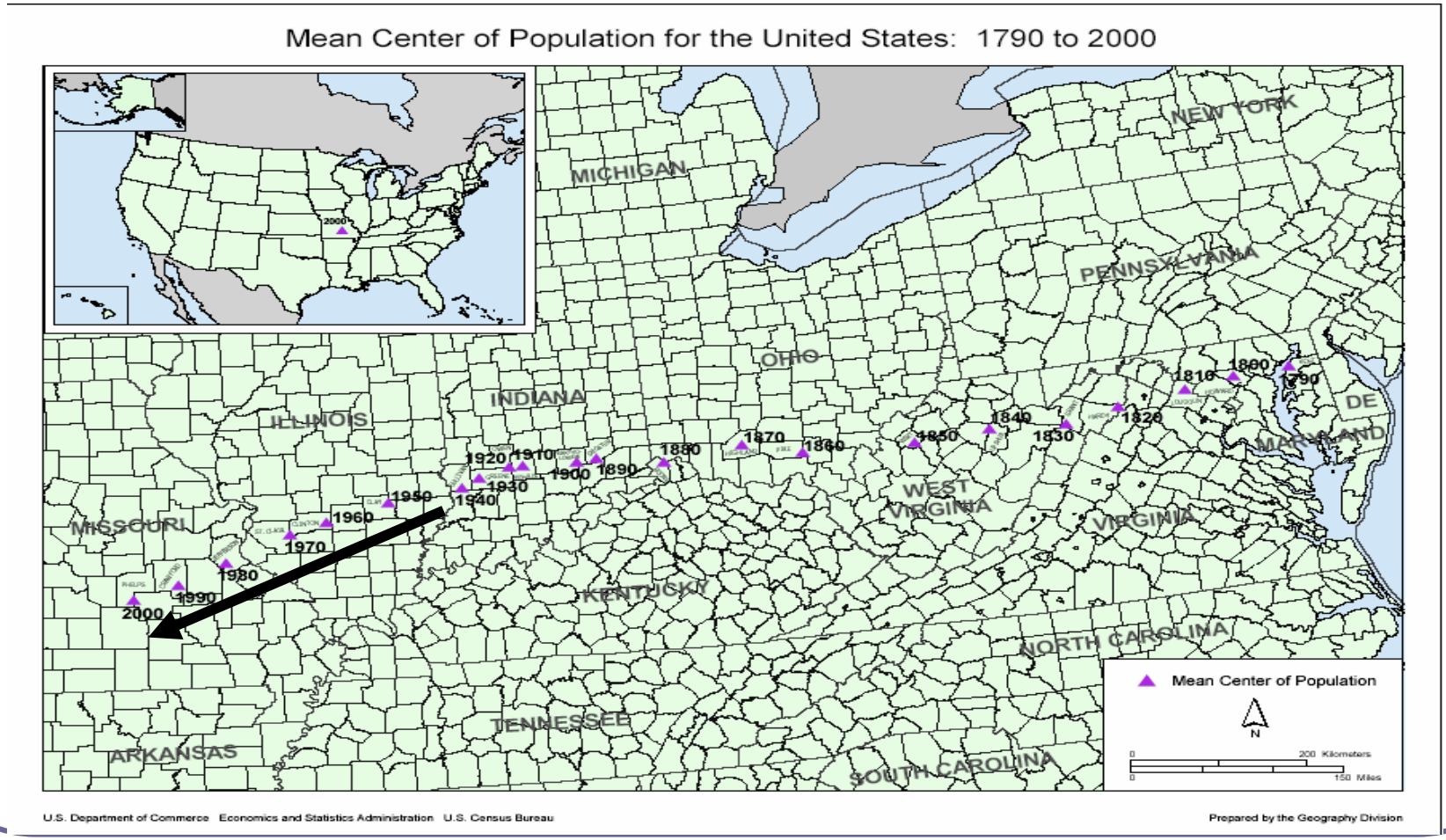
What Drives The Numbers?

- Another round of new investments to deal with a growing population & economy.
- For the first time, substantially adjusting financial approaches, to meet increasing demands for maintenance, repair, renewal and replacement associated with aging systems.

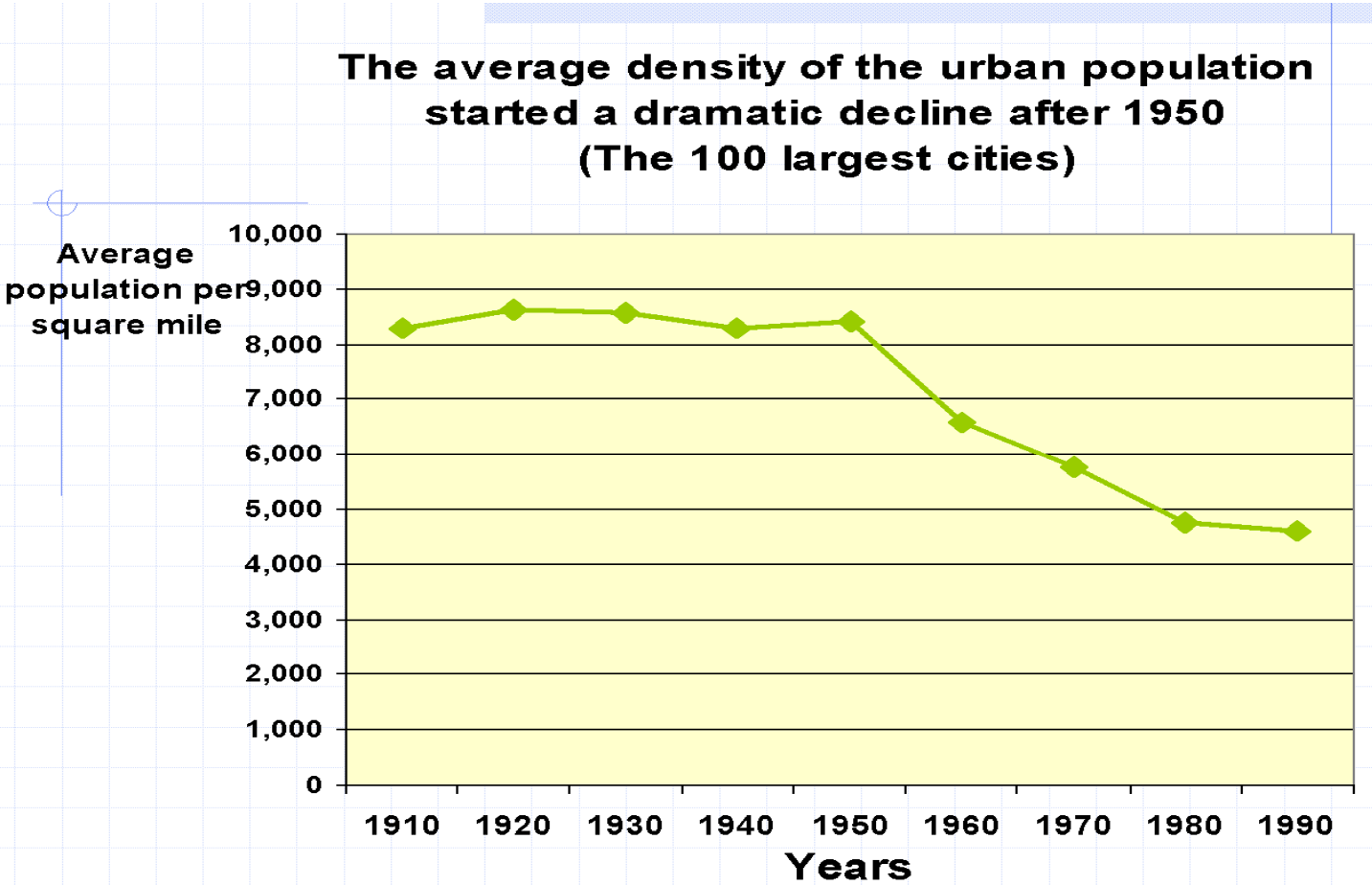
Key Demographic Changes Provide the Backdrop To Understanding The Challenges

Long Life Assets (Water Infrastructure) Are Highly Impacted By Growth Patterns and Long Term Demographic Shifts.

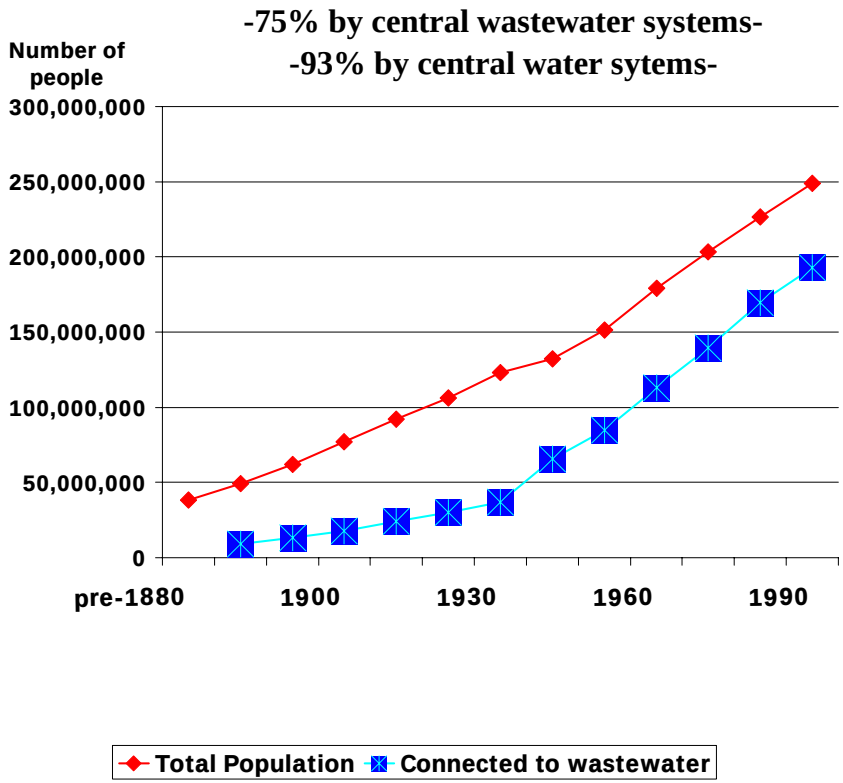
Over The Past Century the Population Increased and The Population Centers Shifted Toward the West and South



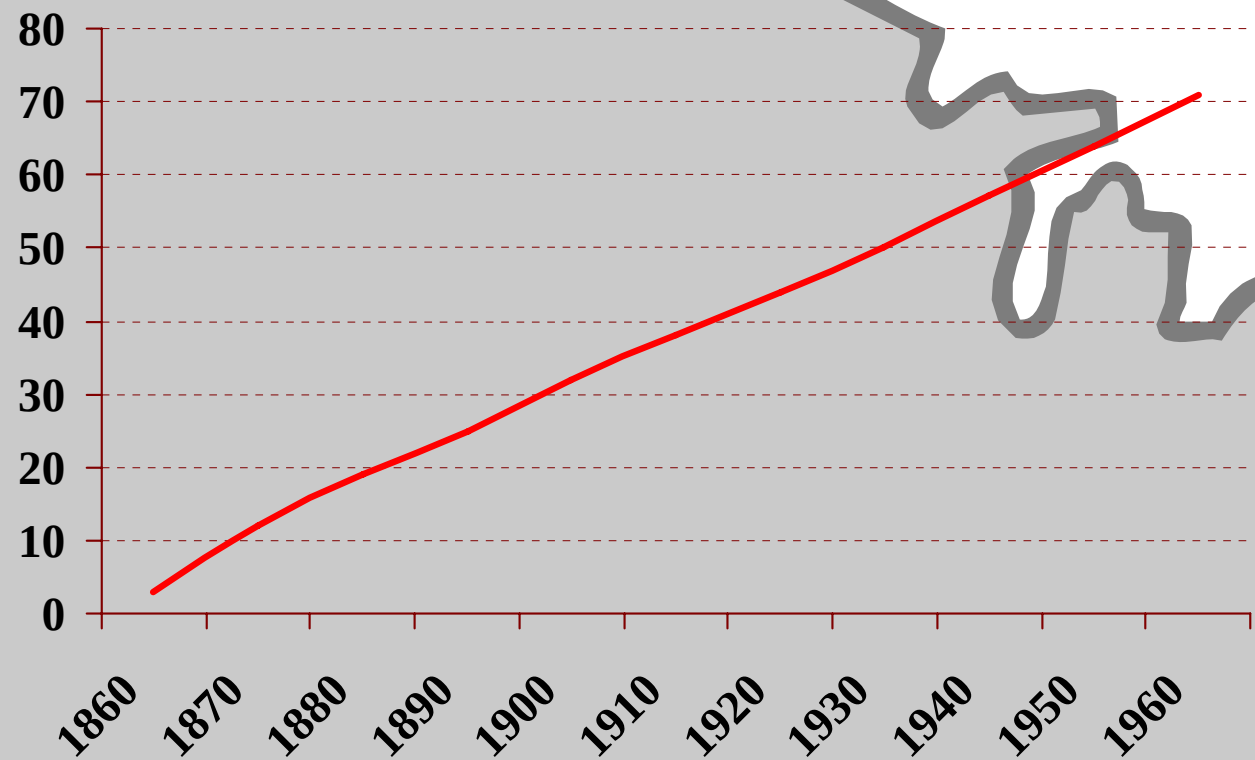
The Density of Our Urban Areas Has Declined



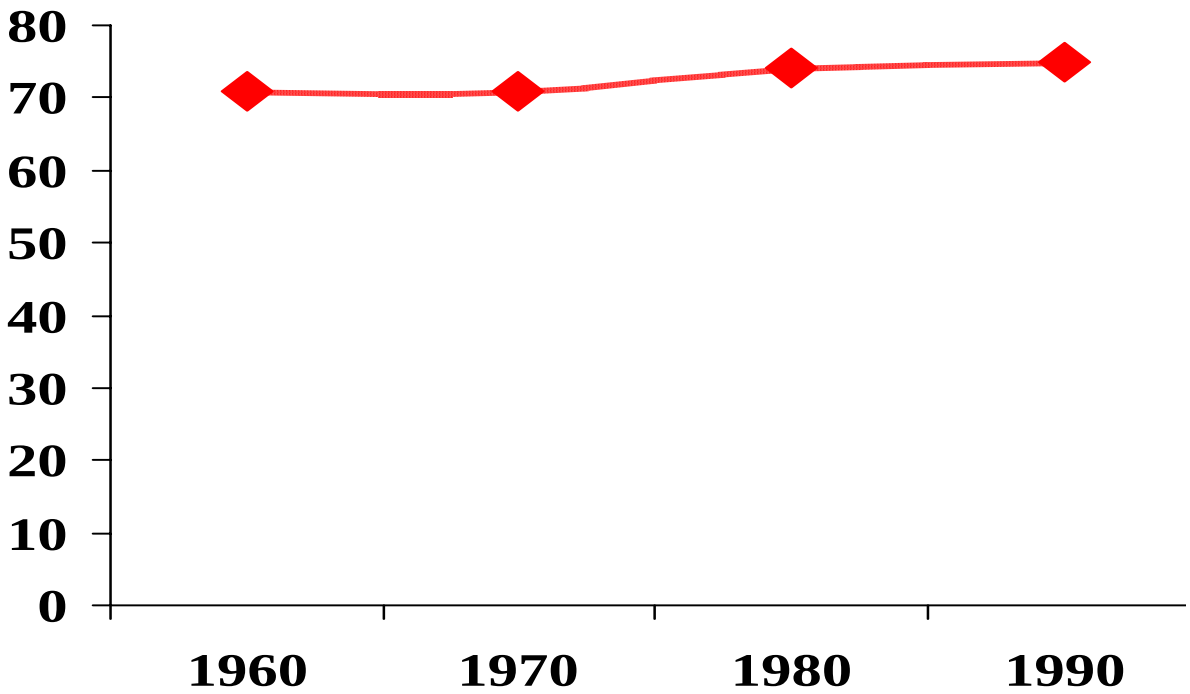
The Population Served By Centralized Systems Increased



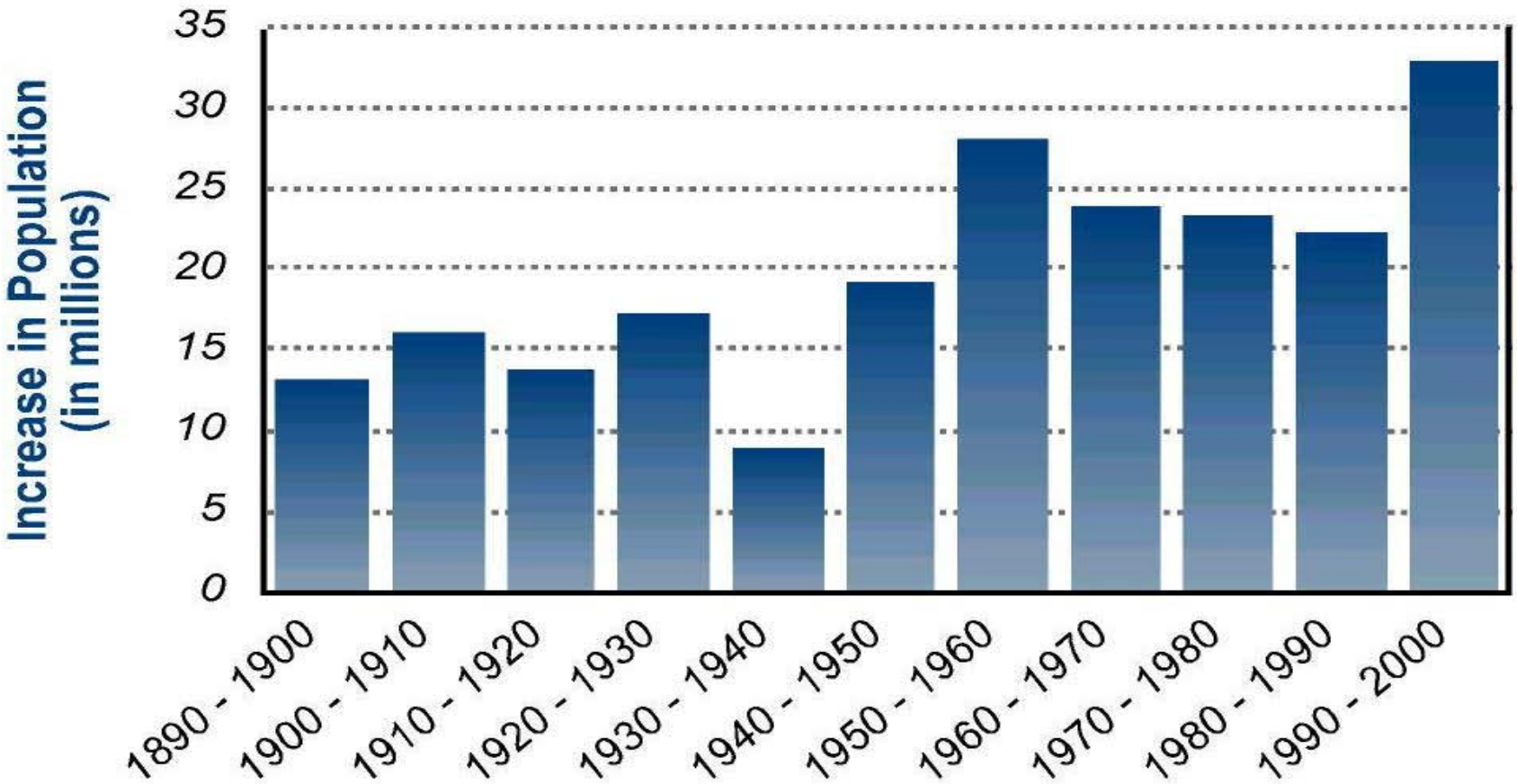
Percent of U.S. Population on Public Sewer



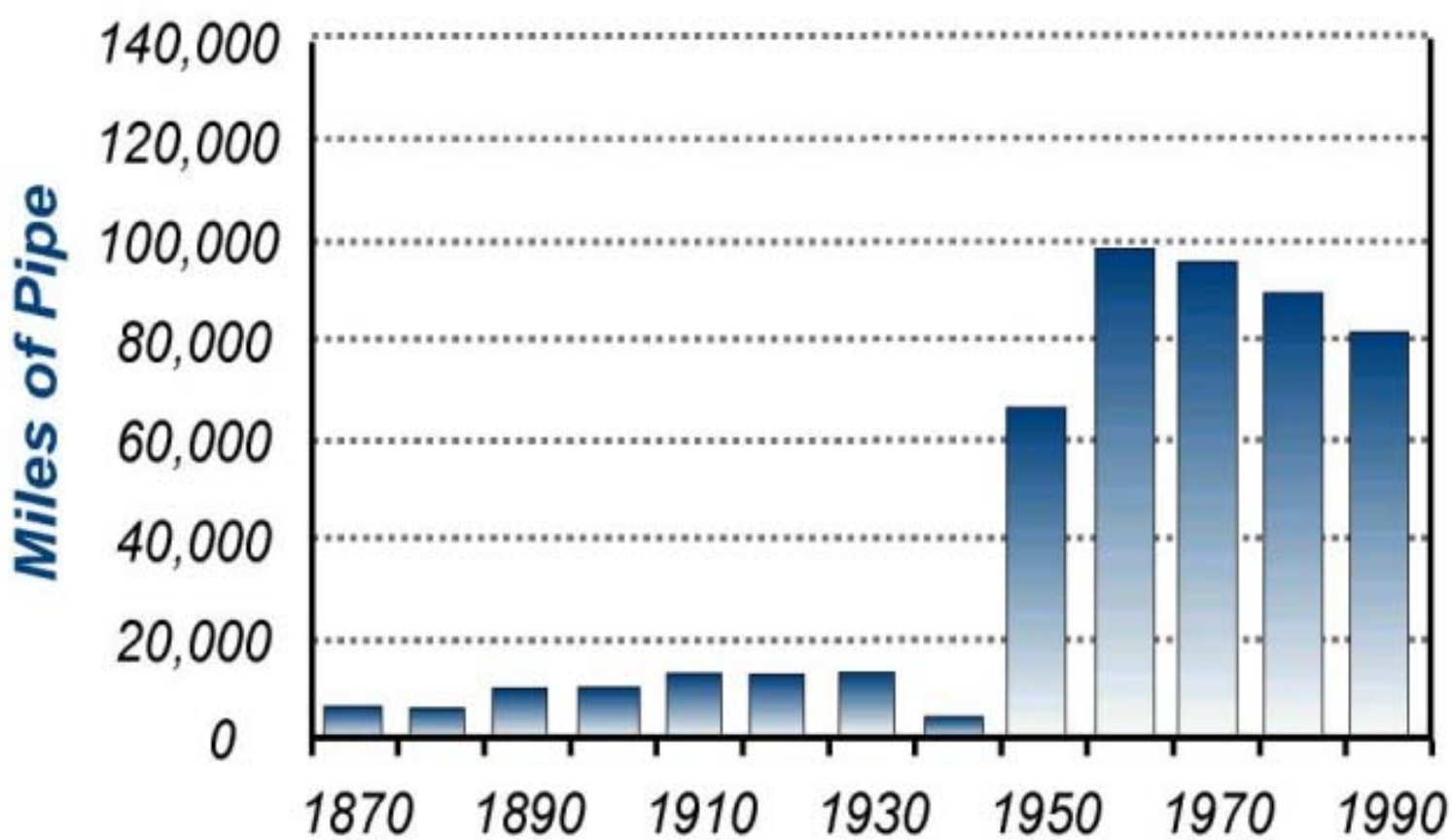
Since the 1960s, The Percentage of the Population Being Served By Centralized Sewer Systems Has Leveled



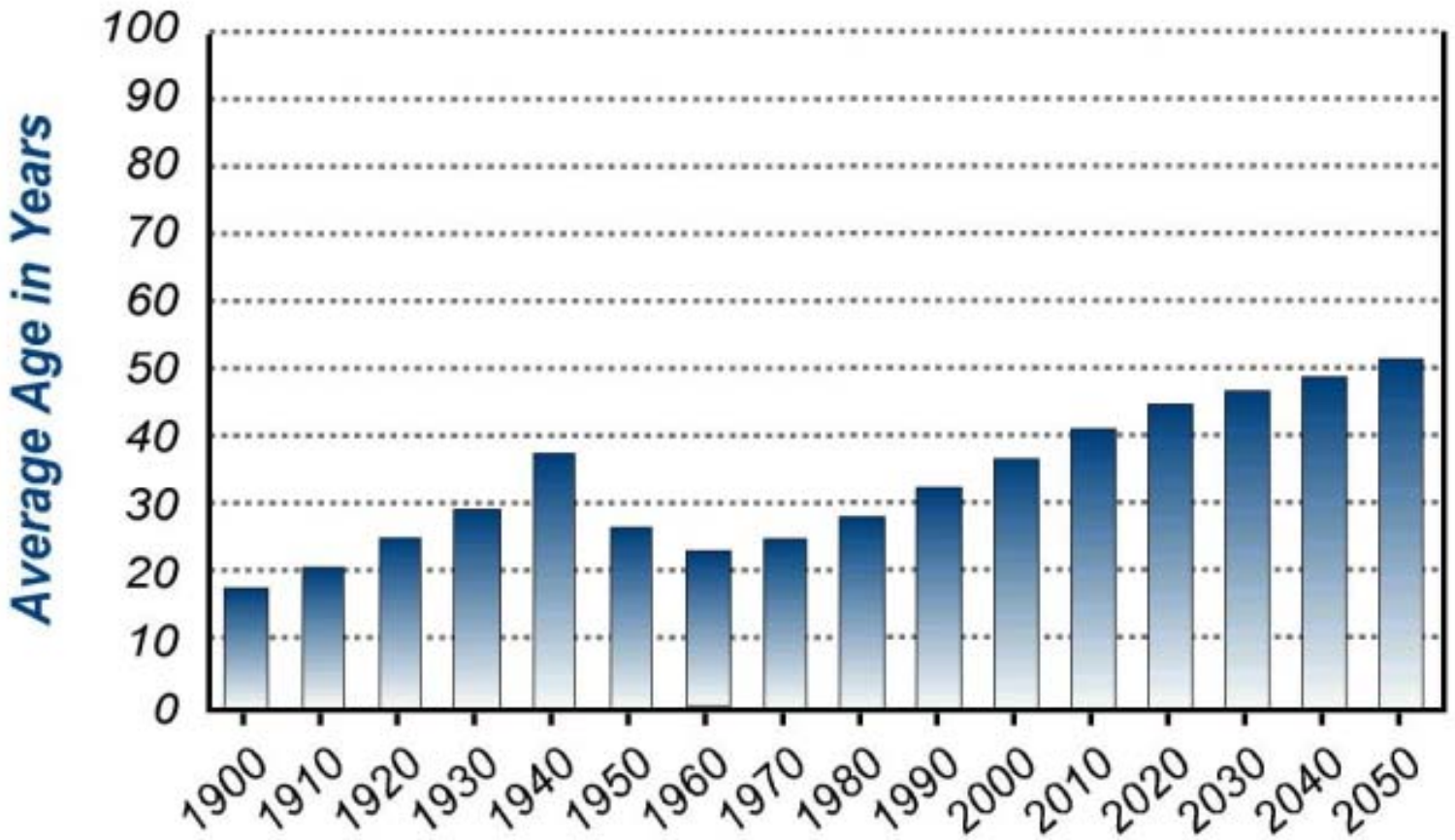
Yet, the U.S. Added Over 30 Million People Between 1990 and 2000 - - the Results Is Growth Continues In the Number of People Served By Centralized Systems



The Vast Majority of the Pipe Networks for Distribution and Collection Have Been Built Since The End of World War II



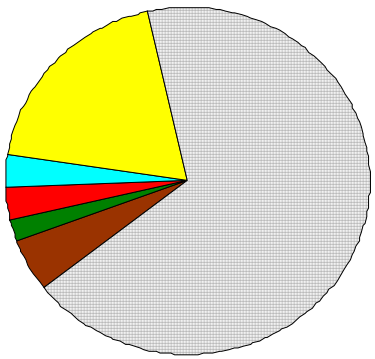
The Challenge of Dealing With The Aging of These Networks Will Be A Generational Issue For Years To Come



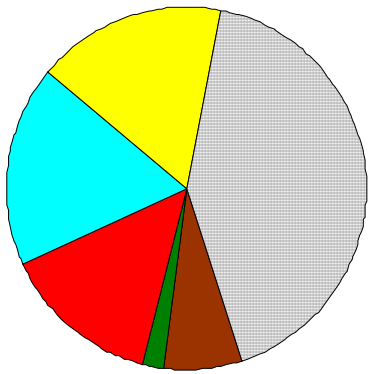
More Pipe in Lower Condition Levels Will Impact Costs and Performance

Excellent
Good
Fair
Poor
Very Poor
Life Elapsed

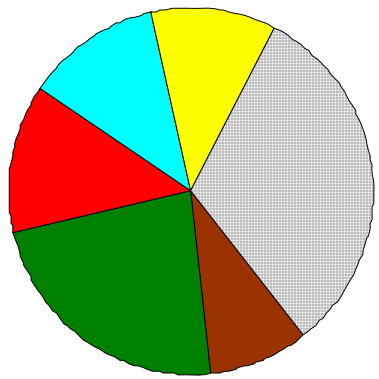
1980



2000

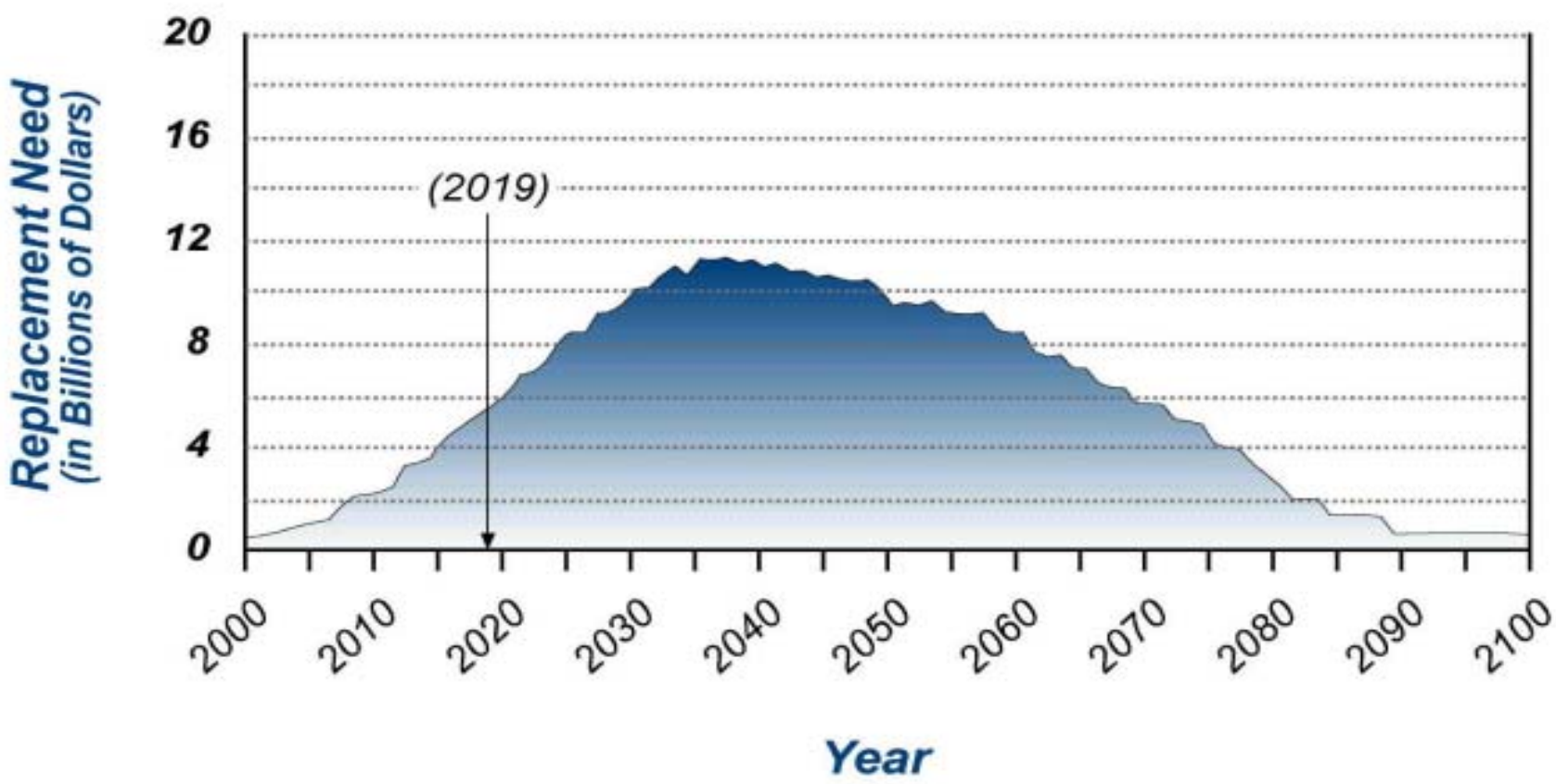


2020



Approximately 2 - 2.5 Million Miles Water / Wastewater: Public / Private

The Challenge Peaks After "2000 - 2019"



This Is Not A " All Broke Crisis" But, on the Way to a Systemic Problem

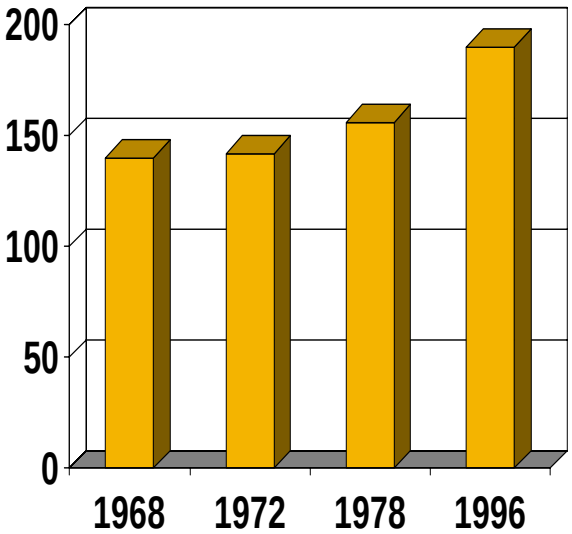
- Our systems are aging.
- The status quo will result in increased public health and environment risk.
- Failure to manage the assets based on life cycle costs will require more revenues over the long term to meet service objectives.

The Recent Focus On Upgrading Service Also Plays An Important Role In Identifying the Dimensions of The Challenges, Ahead

- In the 1970s, The Country Faced Significant Water Quality Problems and Major Policy Changes Were Undertaken.
- The Federal government took on a larger role as a regulator and became a very significant source of funds for capital improvements.
- A new permit process was established to control discharges to the nation's waterways.
- Very large investments were made in the treatment of industrial waste and in the upgrading of the public wastewater systems.

Over The Last Several Decades the Public Investment Has Been Toward Upgrading Service Levels

50 Million More Served

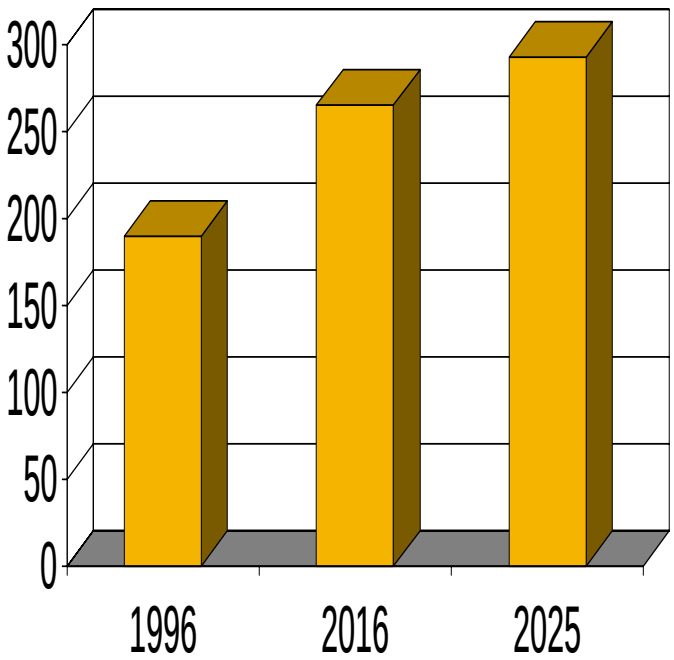


Higher levels of treatment				
	72	82	92	96
Total Plants	19,355	15,662	15,613	16,024
Less Than Secondary	13.4%	19.9%	5.6%	1.1%
Secondary	48.7%	50.7%	58.2%	58.6%
More Than Secondary	2.4%	17.6%	23.6%	27.6%
No Discharge	2.4%	10.2%	12.7%	12.7%

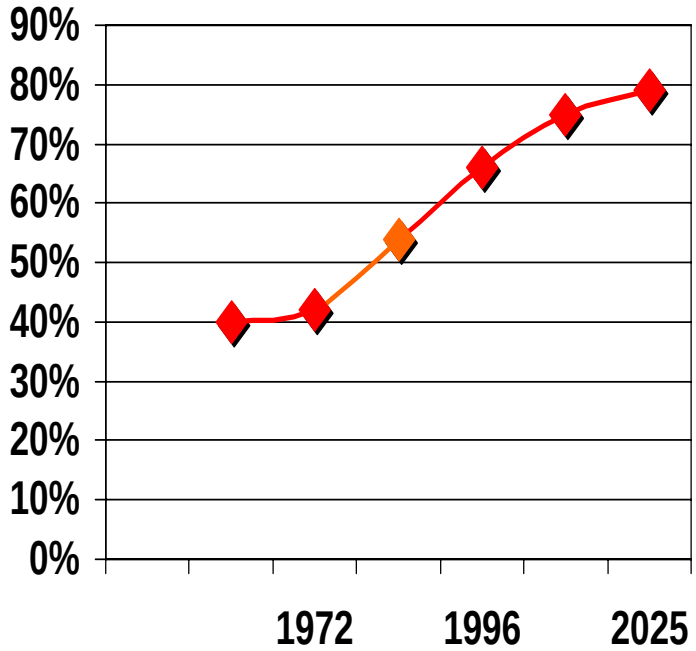
Source: USEPA, Progress in Water Quality. An Evaluation of the National Investment in Municipal Wastewater Treatment, June 2000.

The Emerging Challenge

Additional Served Population1996 to 2025 (In Millions)

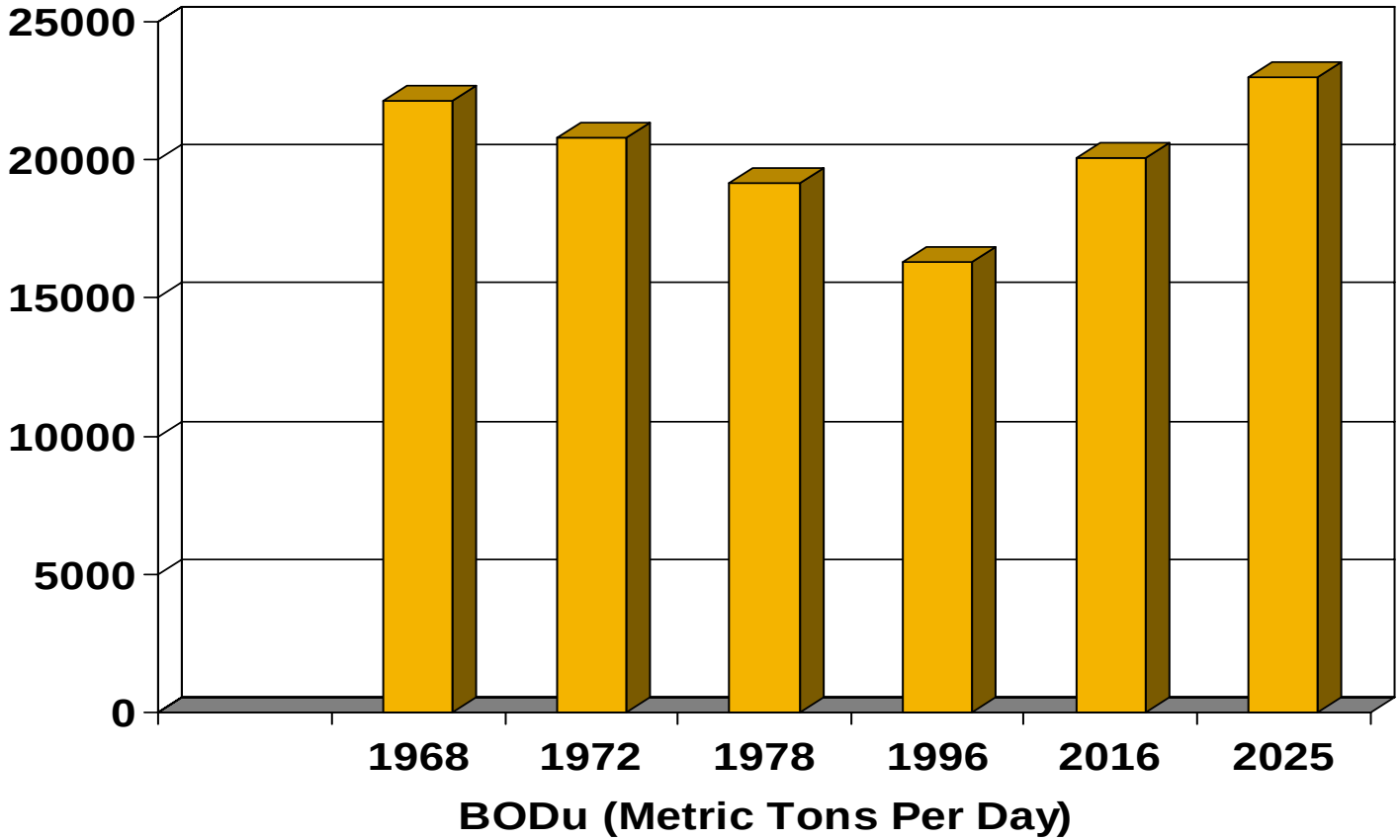


Leveling Off of BOD_U Removal Efficiencies



Source: USEPA, Progress in Water Quality: An Evaluation of the National Investment in Municipal Wastewater Treatment, June 2000.

The Additional Growth, Could Produce by 2016, BOD_U Loadings to the Waters Similar to the Mid-1970s



Source: USEPA, Progress in Water Quality: An Evaluation of the National Investment in Municipal Wastewater Treatment, June 2000.

Placing an Emphasis on Tackling the Problems Produced Results, However !

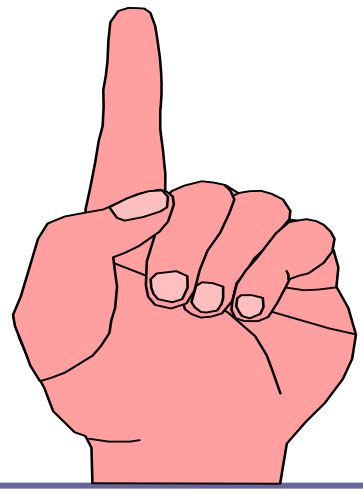
- **Infrastructure challenges are not addressed through a one time fix, but rather a sustained commitment.**
- **The emerging focus is on taking the steps necessary to retain the gains achieved from the major investment of the last thirty years.**
- **The largest change in meeting the emerging challenge is that for the first time, in addition to making new investments, renewal and replacement of existing systems.**

Change Goes Beyond Additional Dollars

- Reduce the rate of increase in cost.
- Innovation and new technology
- Sustainable approaches
  - adoption of best management practices,
  - right sizing of service delivery,
  - asset management approaches,
  - environmental management systems,
  - Smart and efficient water use.
- Integrated system wide thinking on reliable onsite.
- Watershed-based decision making.
- Public participation and transparency in decision making.

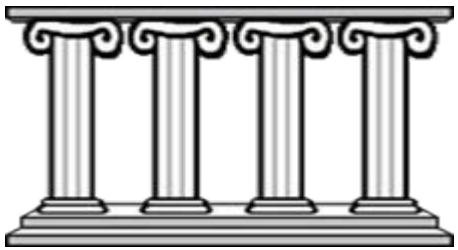
As We Look To the Future, One Thing That Is Unquestionably Critical To Sustainability!

That Utilities Are Able to Do Their Work Expertly On Into The Future

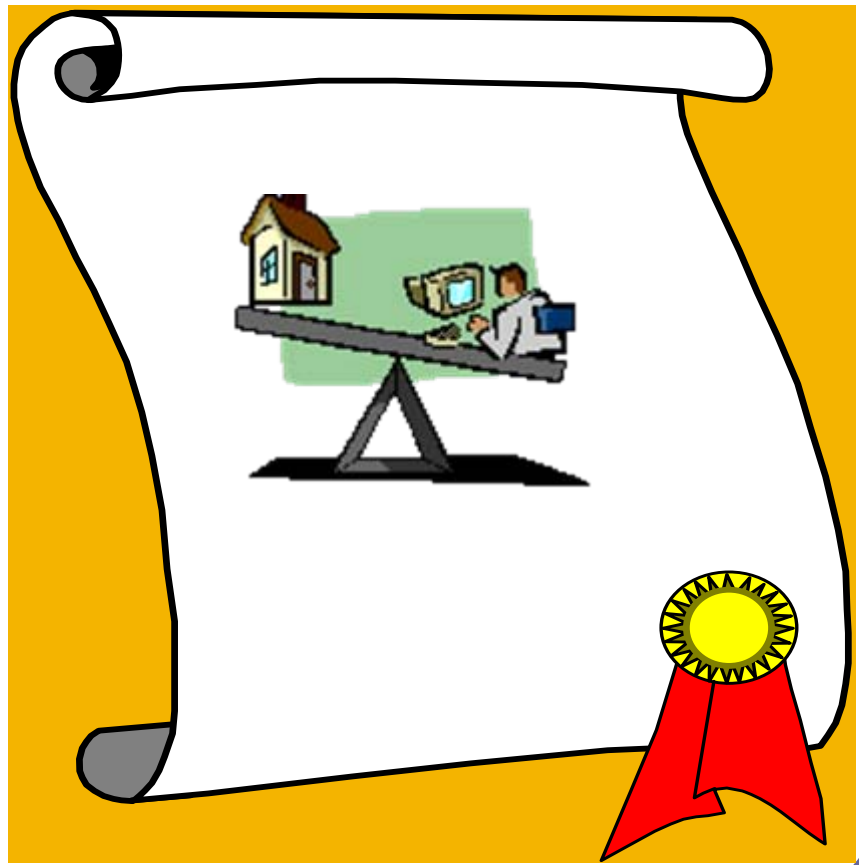


EPA Has An Agenda That is Designed to Support The Pursuit of Sustainability

- SRF Plus



- ✓ Better management
- ✓ Water efficiency
- ✓ Full cost pricing
- ✓ Watershed approach



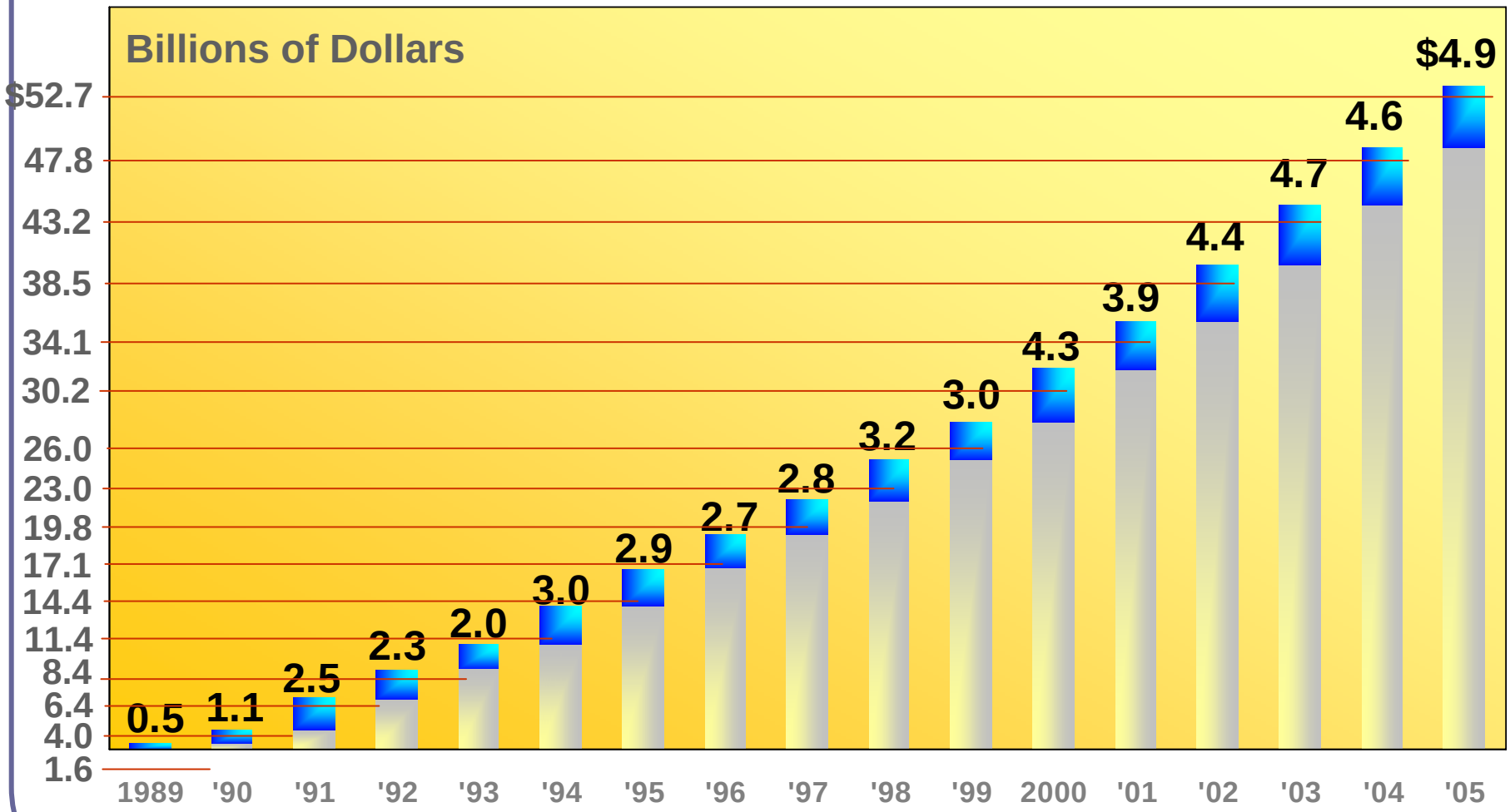
Local Governments As the Owners of Systems Are The Focal Point In Fostering Sustainable Infrastructure

- **No single initiative will provide the entire venue for sustainable infrastructure. Yet, each pillar has great potential to contribute toward a solution and none has been fully exploited.**
- **Taken together, and used in a coordinated fashion the pillars offer a focused framework for strategically moving toward a sustainable arrangement.**

The State Revolving Fund Program

A Record of Success

CWSRF Cumulative Assistance Exceeds $52.7 Billion



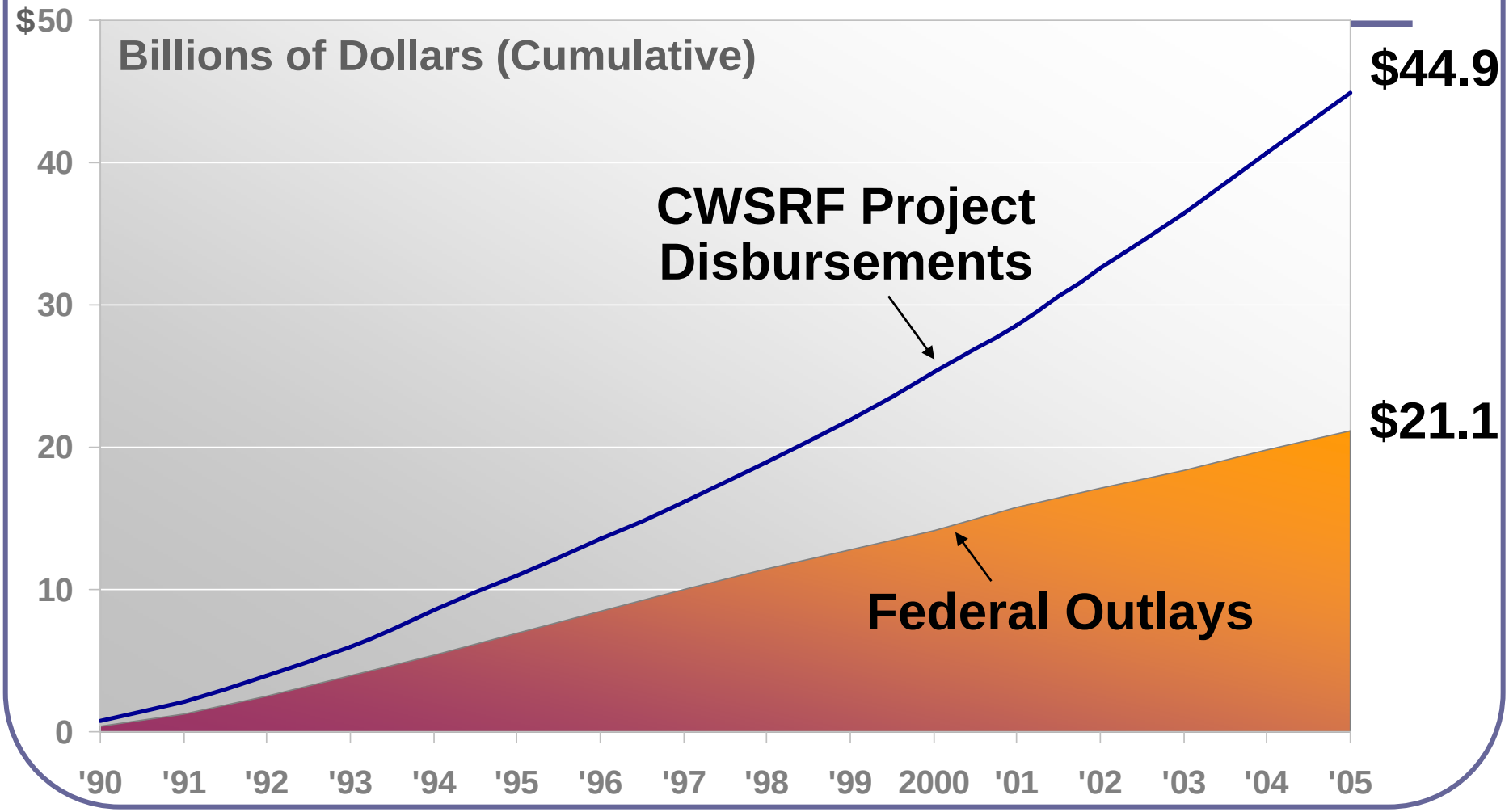
Annual Number of Loans Averages 1,400

Cumulative Number of Loans Exceeds 16,700

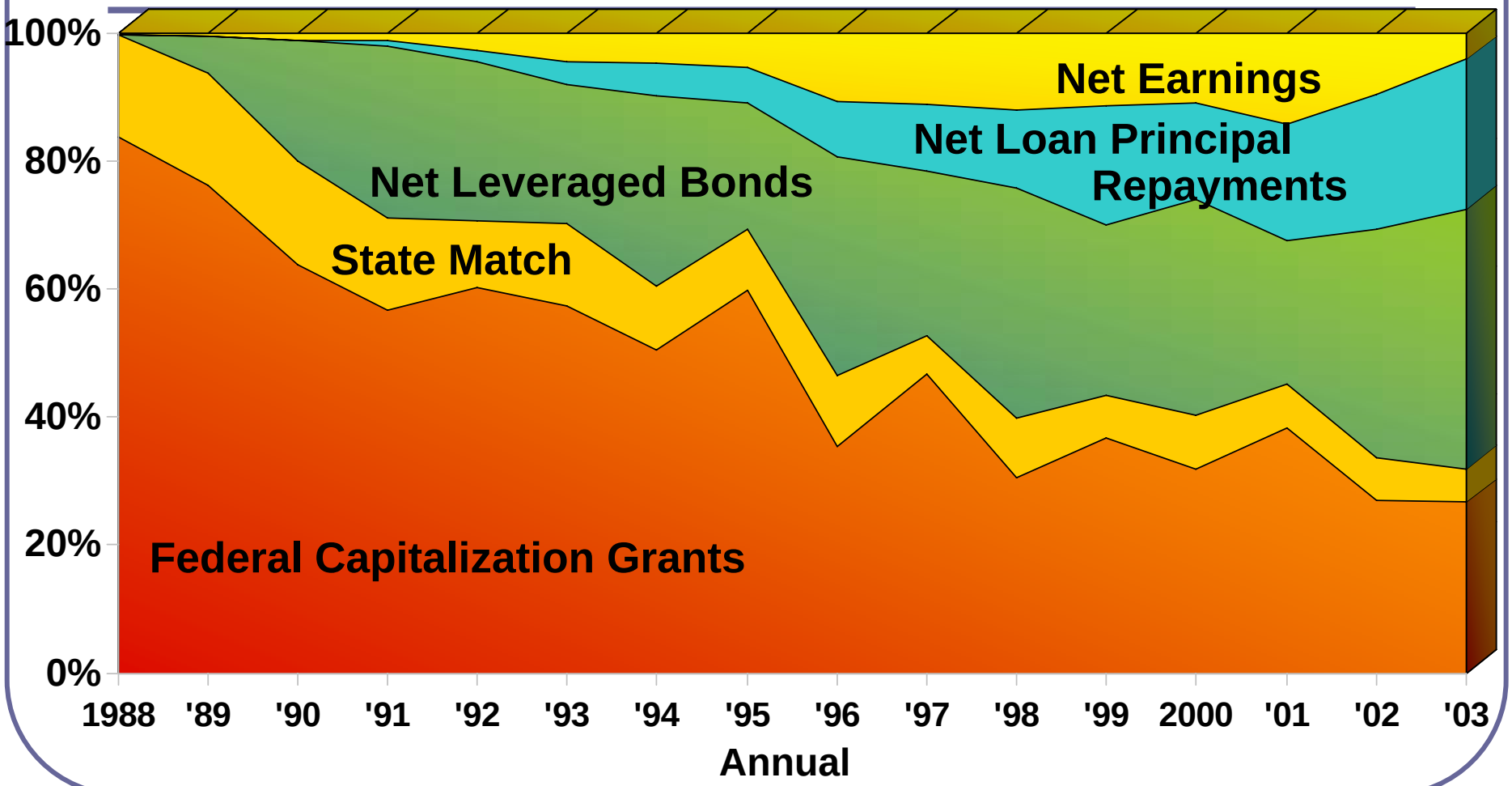
Annual

Cumulative

CWSRFs Return 2.12 Times the Federal Investment



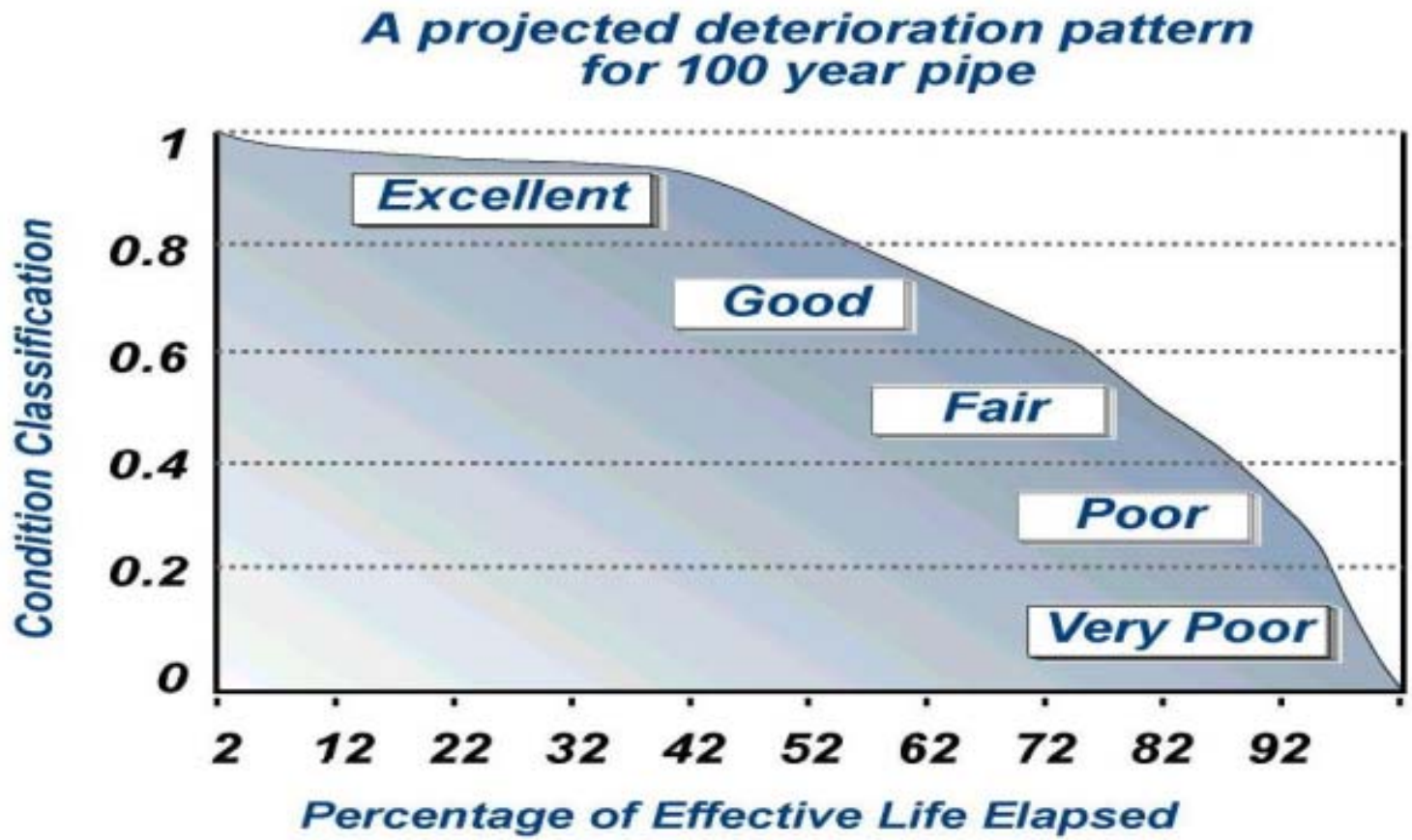
The Relative Share of Sources of Funds Continues to Shift



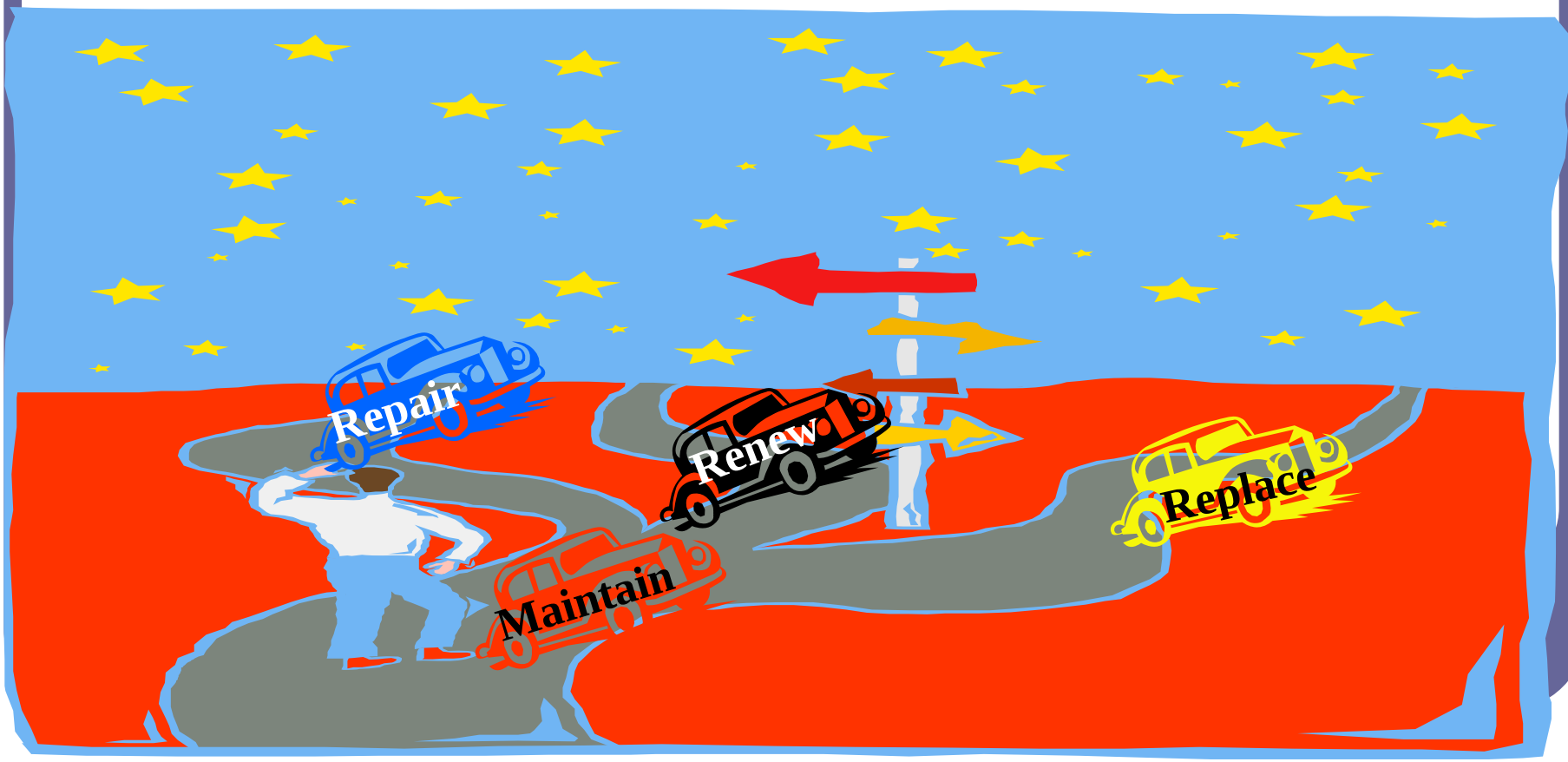
The Focus of This Discussion
Asset Management 101

All Physical Assets Deteriorate and Eventually Fail…*Unless they are properly maintained and renewed or replaced*

Some Asset Deteriorate Quickly, Others Over Generations



The Heart of Managing a Successful Water or Wastewater Service - - Becoming Expert at Maintenance, Repair, Renewal or Replacement Decision Making



Asset Management Is A Critical Building Block In Bring About Sustainable Infrastructure

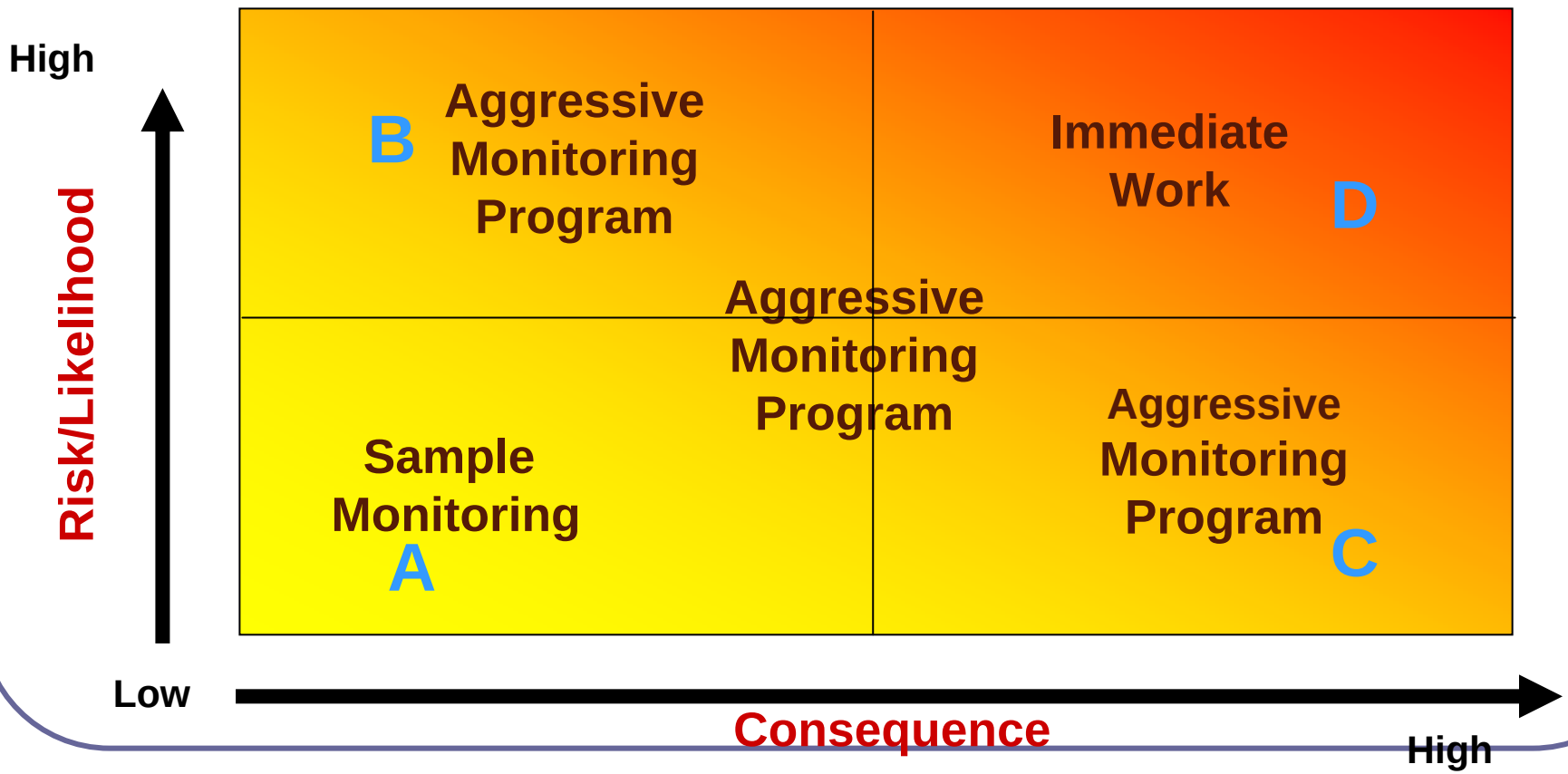
better acquisition,
operations, maintenance, and
renewal and replacement
DECISIONS

All Assets Are Not Created Equal!

(Criticality) is a function of "Consequence" & "Likelihood" of Failure

What is the
likelihood of failure ? (risk)
&
What is the cost
of failure? (consequence)

Failure Risk/Consequence Should Drive The Work Program



The USEPA Asset Management Training Workshops Focus

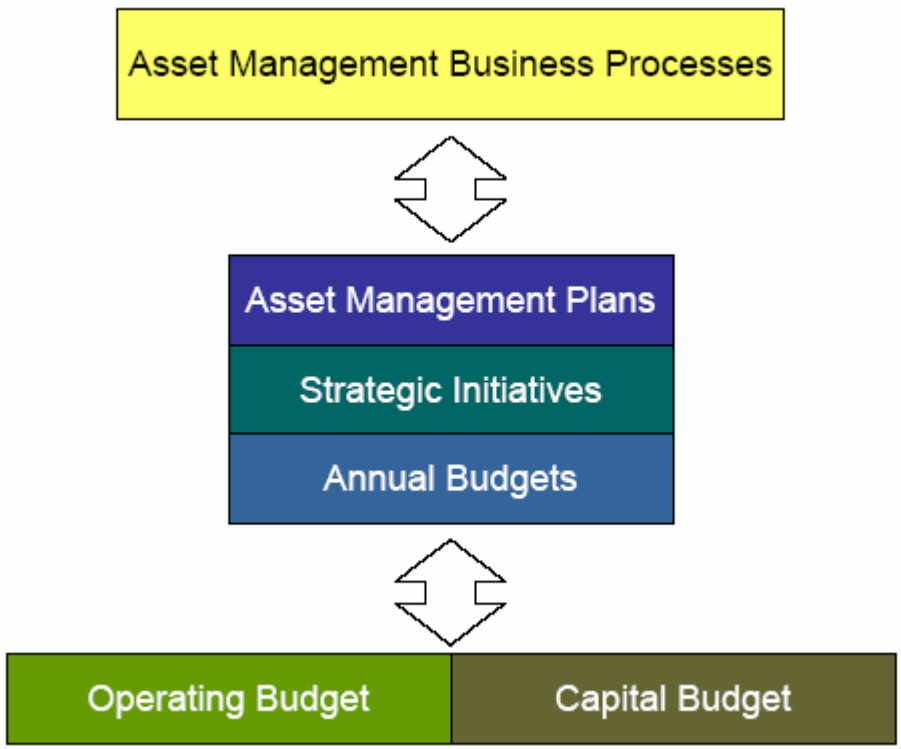
Core Questions, Process & Life Cycle Cost

When Asset Management Is Examined It Can Be Explored From Any One of Several Perspectives

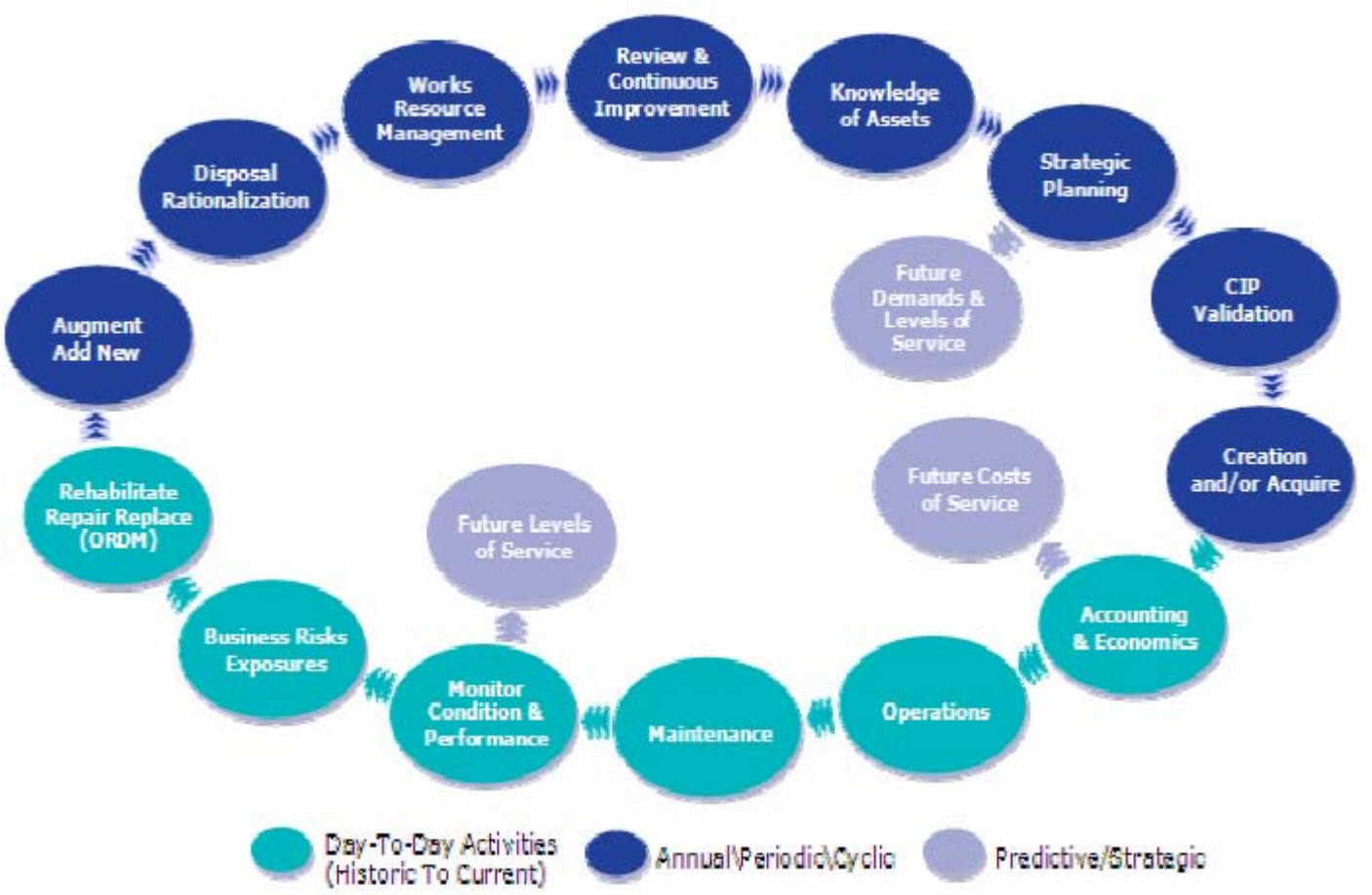
- The “Quality Elements”
- The “Management Framework”
- The “5 Core Management Questions”
- The “ 10 Core Processes and Practices”

The “Quality Elements” View

The "Management Framework" Perspective

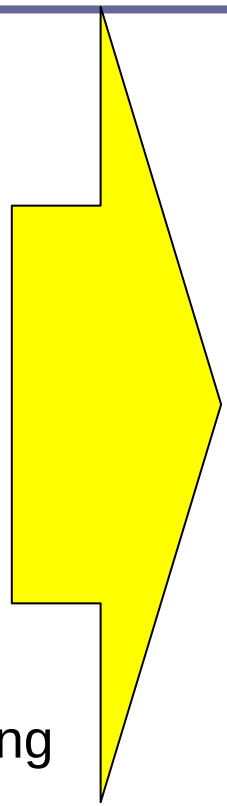


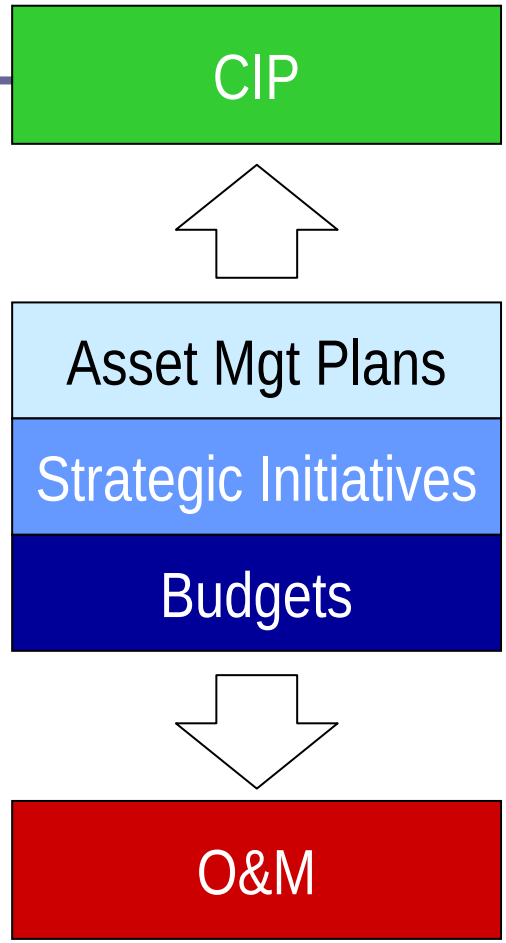
The Asset Life Cycle Viewpoint



AAM Has Fundamental "Building Blocks". Improving the Detailed Knowledge Regarding The Building Blocks Greatly Informs The Management Processes

1. Definition
2. The asset life-cycle
3. How assets fail
4. Risk-consequence
5. Cost/valuation
6. Asset demand
7. Level of service
8. Business risk
9. Confidence in decision-making





Asset Management Core Questions?

1. **What Is The Current State Of My Assets?**
2. **What Is My Required "Sustainable" Level Of Service?**
3. **Which Assets Are Critical To Sustained Performance Core**
4. **What Are My Minimum "Life-cycle-cost" CIP and O&M Strategies?**
5. **Given The Above, What Is My Best Long-term Funding Strategy?**

Problem Solving by Answering Core Questions

What is the current state of my assets?

- What do I own?
- Where is it?
- What condition is it in?
- What is its remaining useful life?
- What is its economic value?

What is my required sustained Level Of Service?

- What is the demand for my services by my stakeholders?
- What do regulators require?
- What is my actual performance?

Which assets are critical to sustained performance?

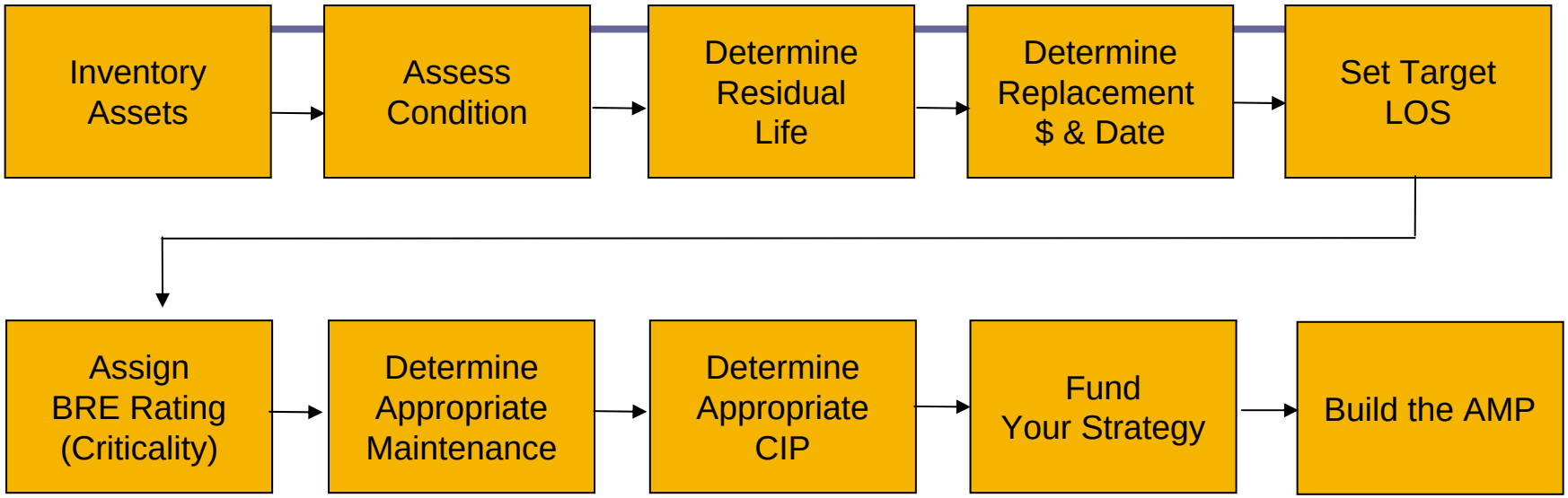
- How does it fail? How can it fail?
- What is the likelihood of failure?
- What does it cost to repair?
- What are the consequences of failure?

What are the best “life-cycle-cost” CIP and O&M strategies?

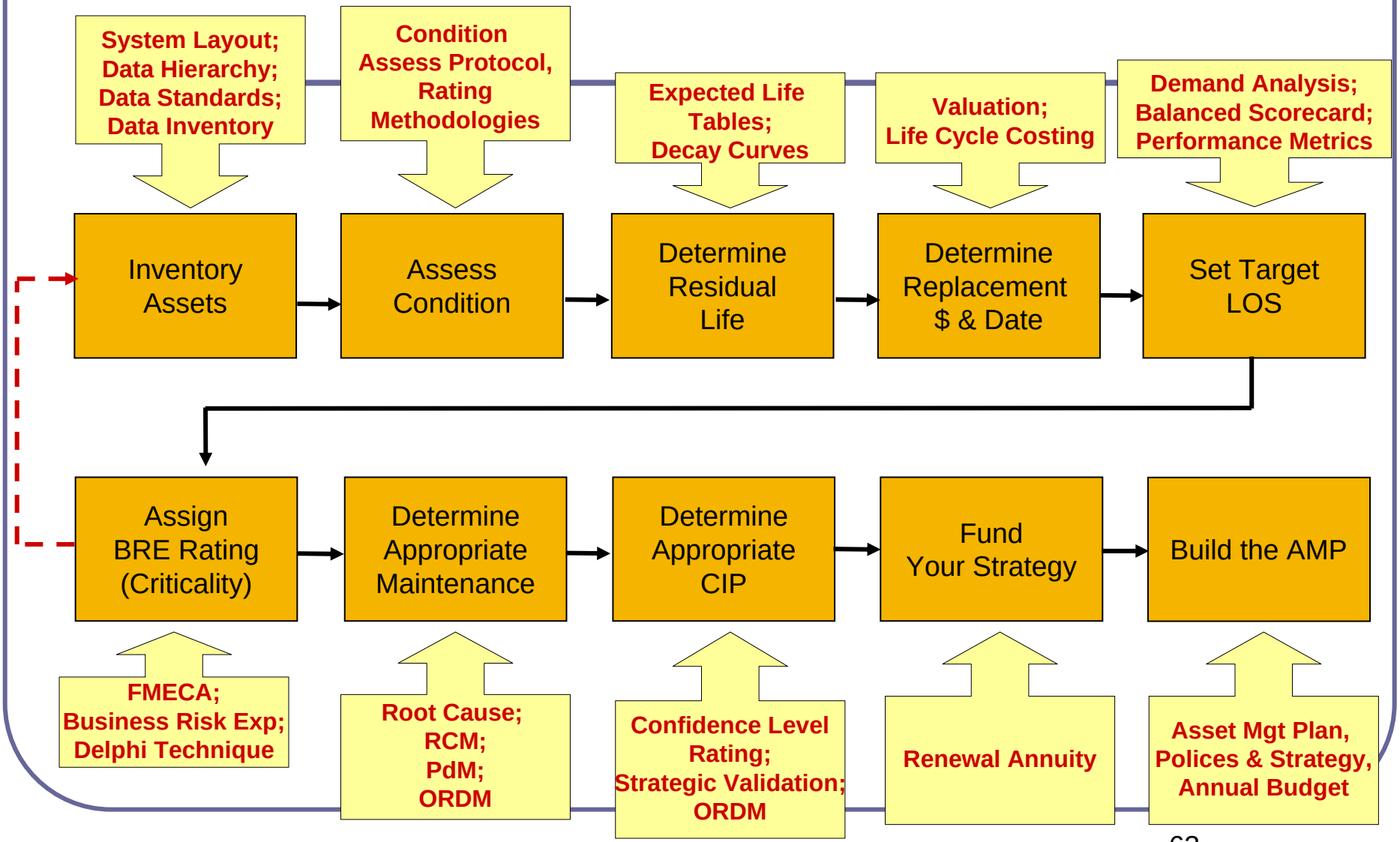
- What alternative management options exist?
- Which are most feasible for my organization?

Given the above, what is the best long-term funding strategy?

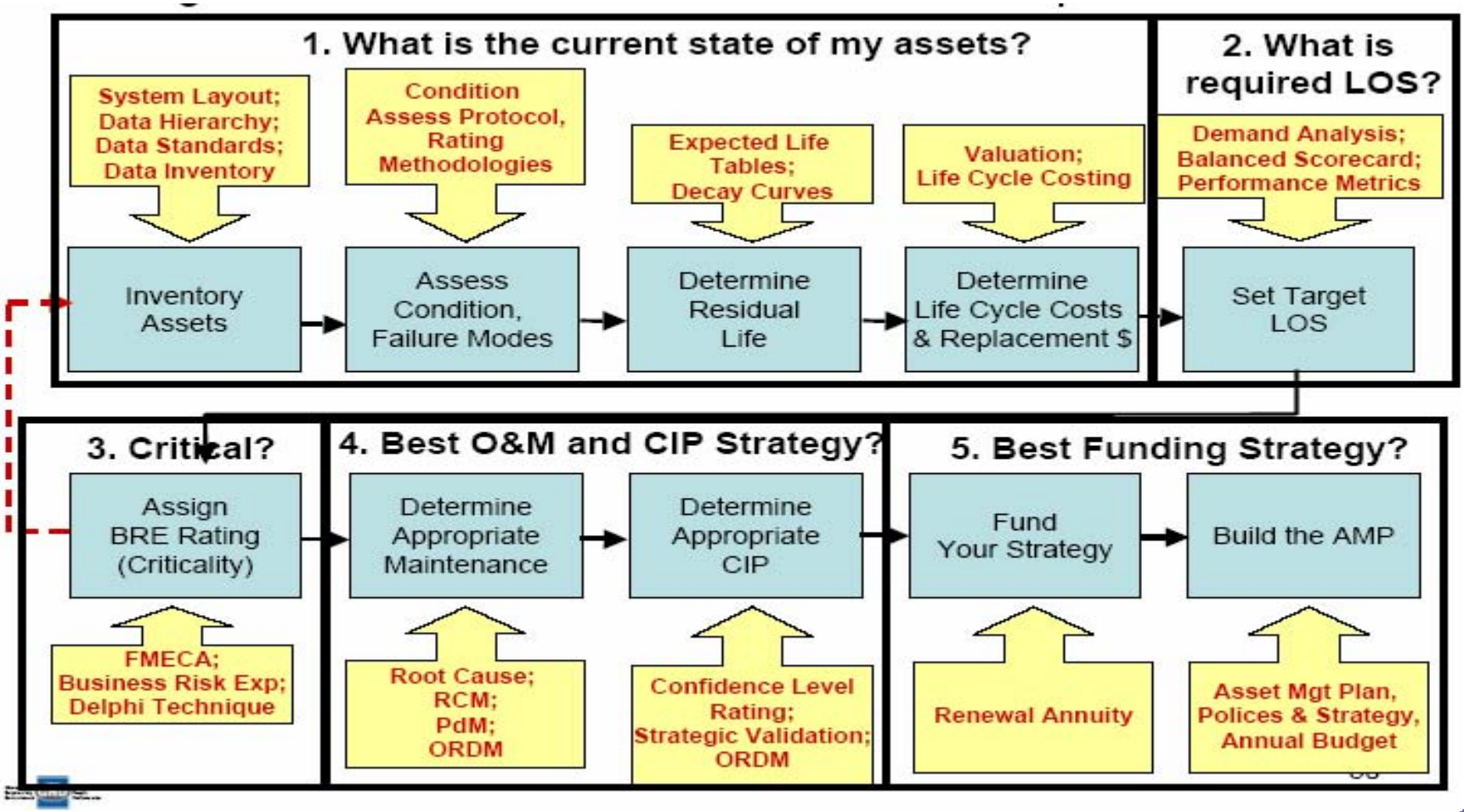
An Advanced Asset Management Program Process

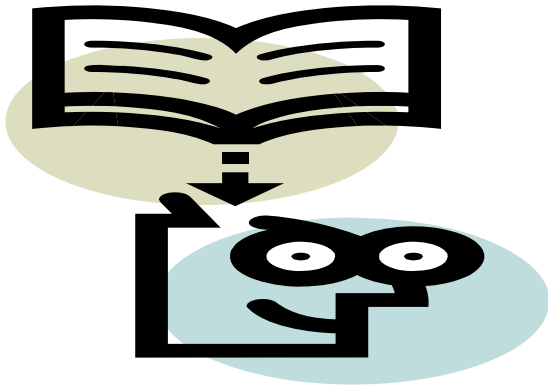


Core Process Steps & Related Tools



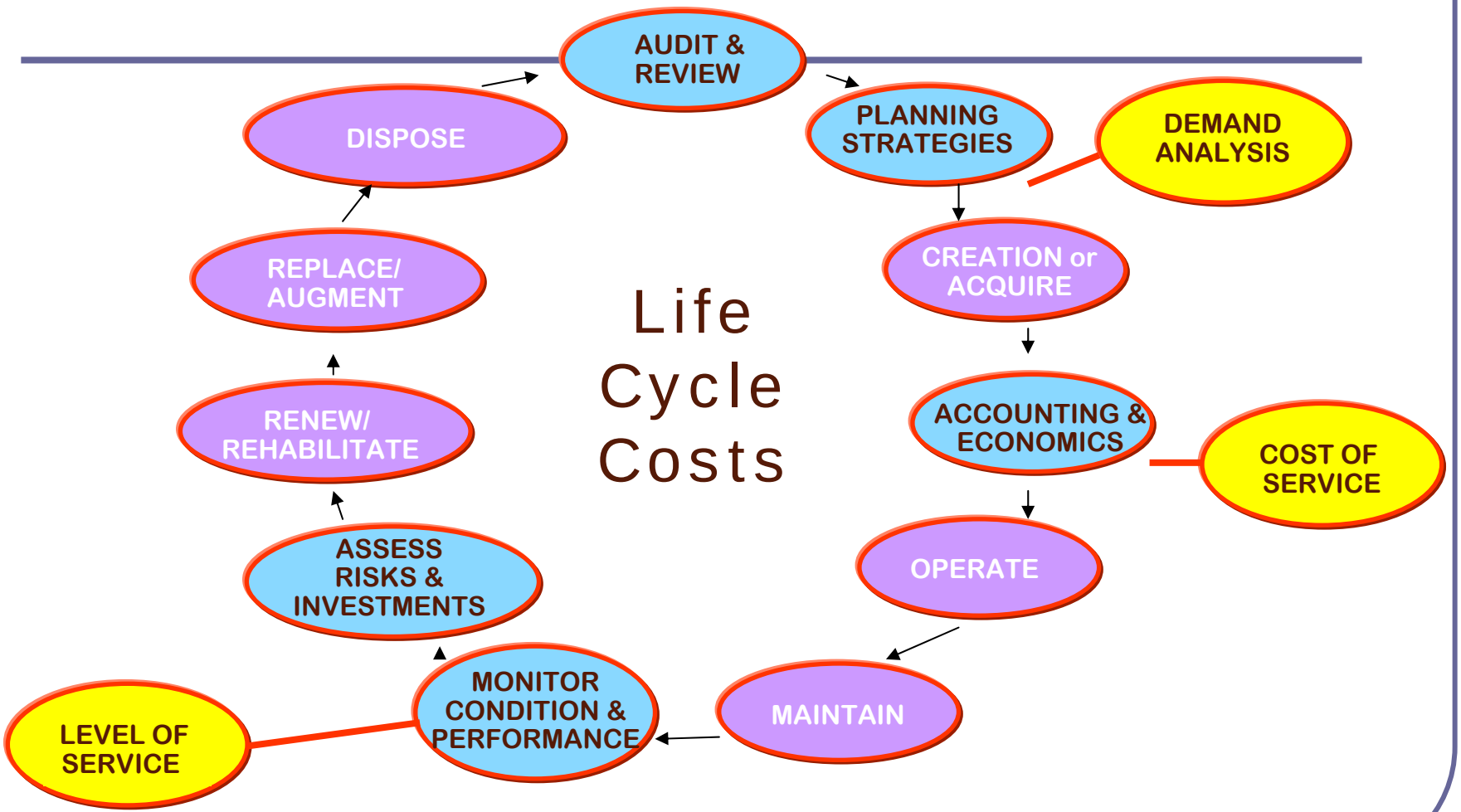
Relating The Five Core Questions To the "10 Step AMP Process"



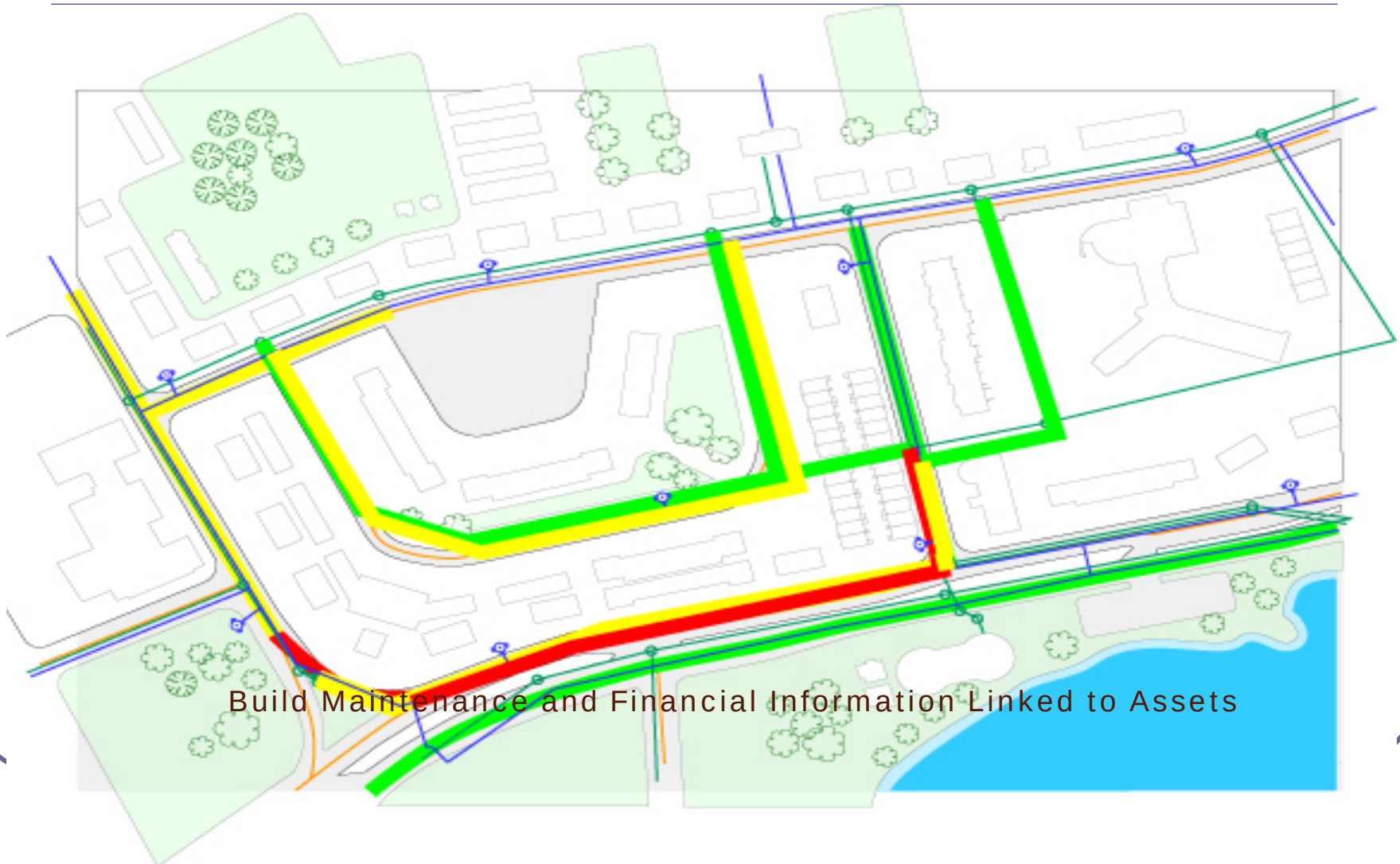


What I have Learnt: Pay Major Attention to the Fundamental

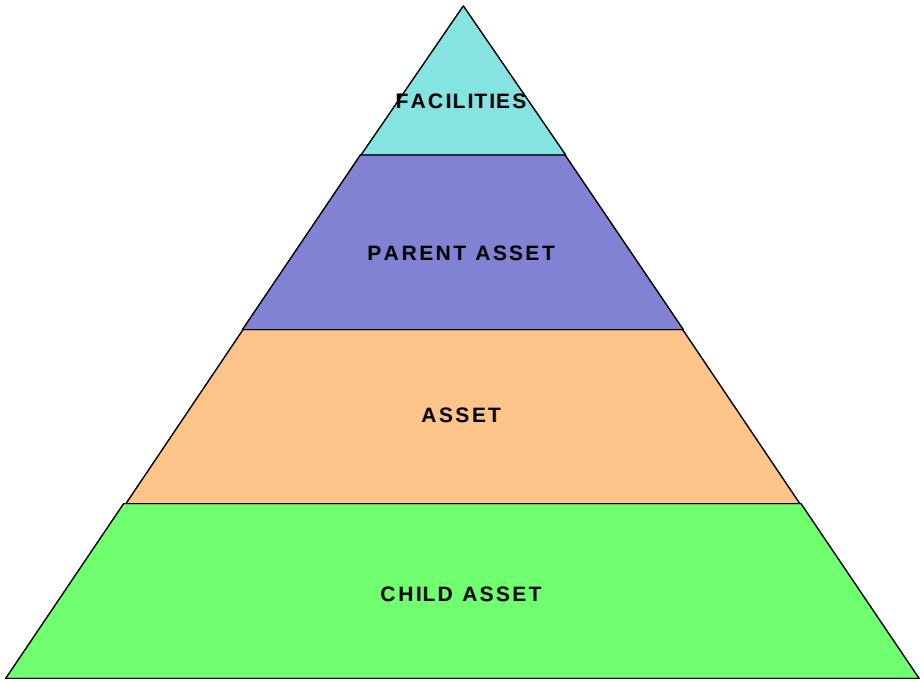
A Sustained Course of Action Requires a Complete and Transparent Understanding of the Full Liabilities

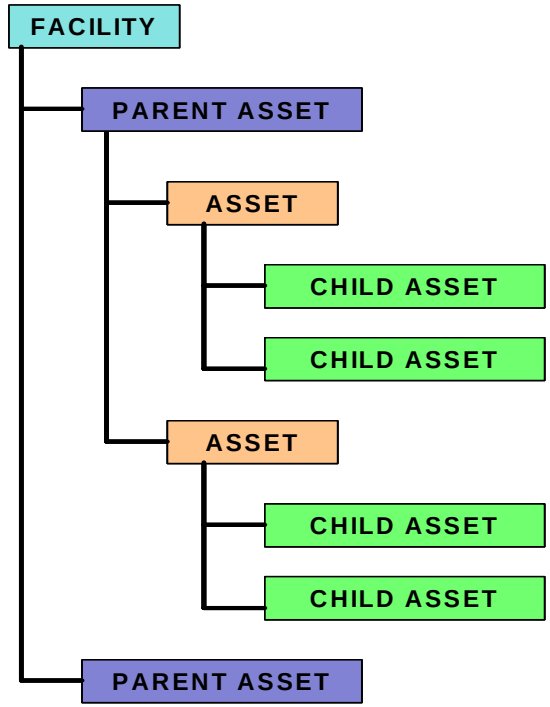


Determining the Current State of Your Assets Starts With Knowing What You Have!



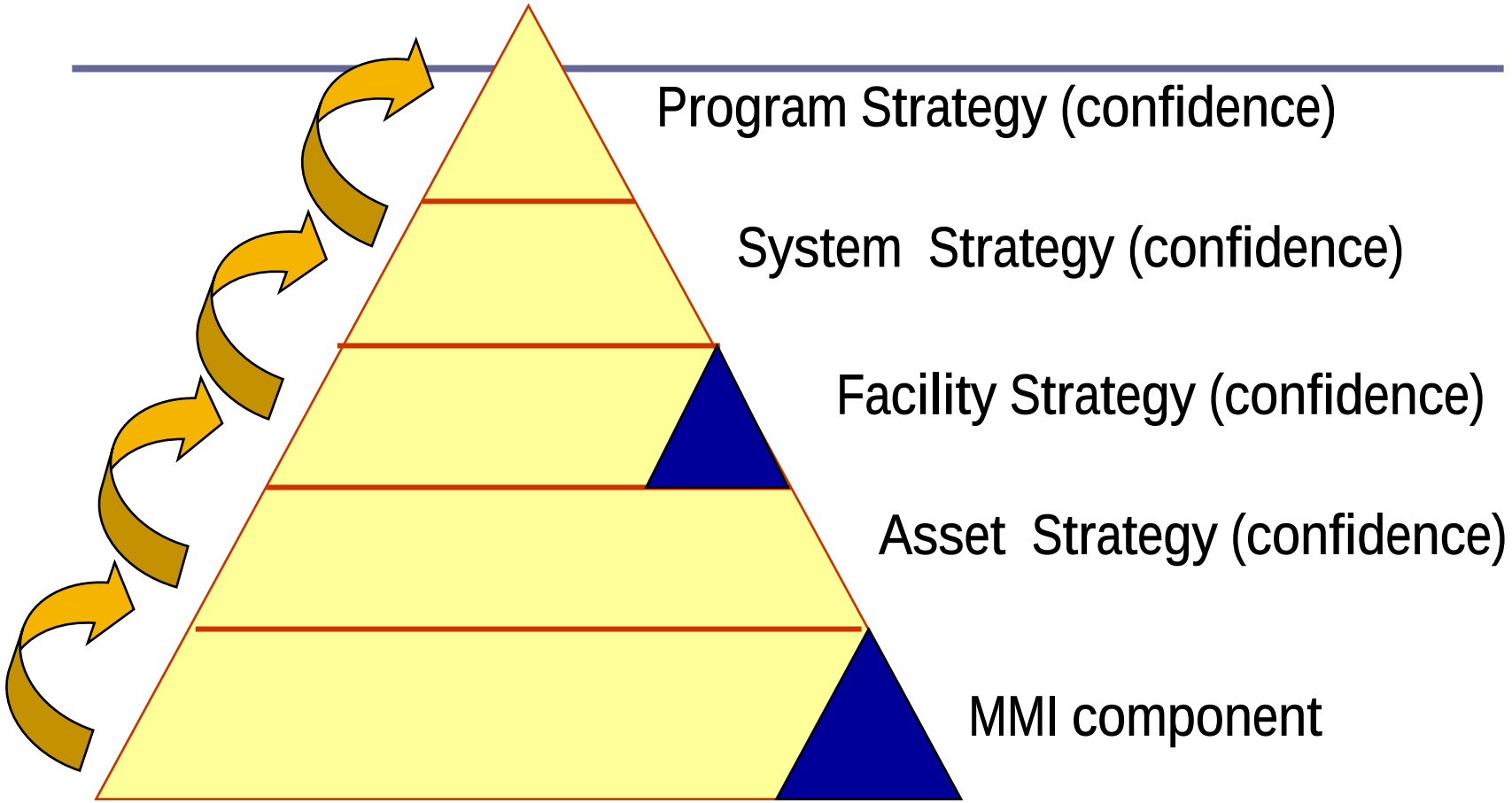
Data Standards and Asset Hierarchy are the Backbone of A Utilities Management Capabilities





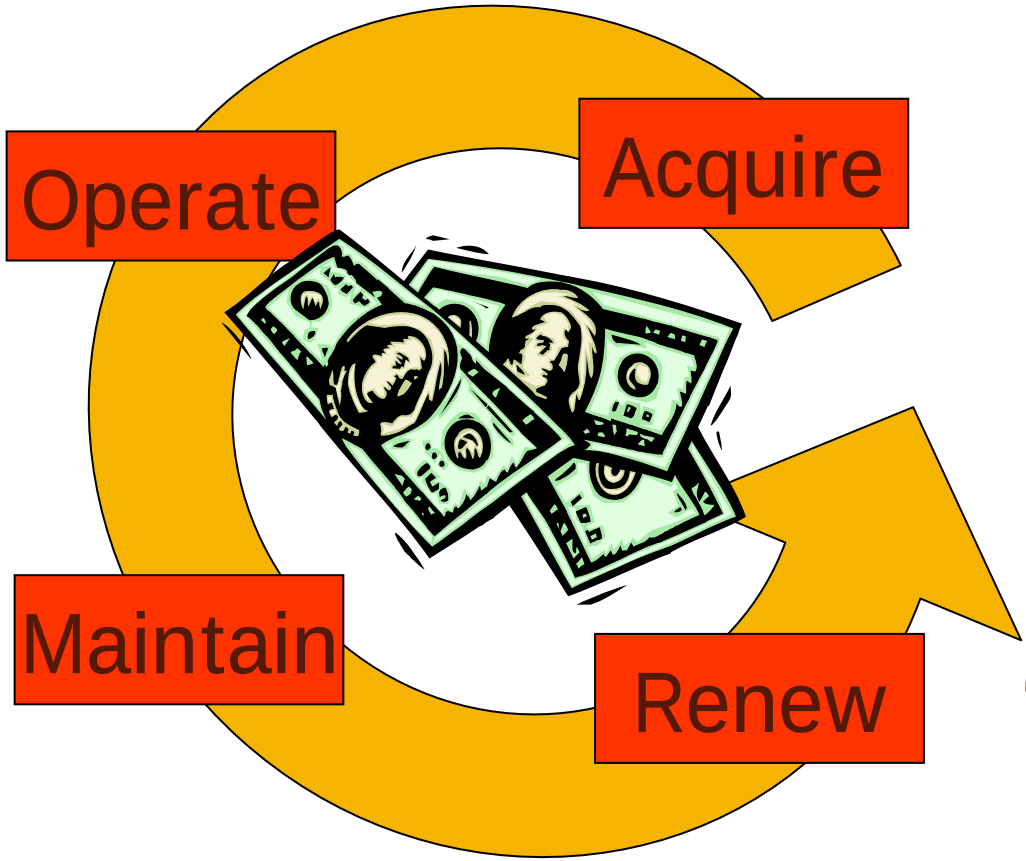
If organized knowledge does not exist on what we have, where it is, what condition it is in, and it's value, we can't possibly take the case that "It" is being managed.

Confidence In A Program Strategy Is A Function Of A Roll-Up



Confidence at higher system levels is determined by Managed Maintenance Item (MMI) component accuracy.

Least Cost Management of the Asset Is About Spending A Dollar At Right Time and On the Right Thing Over The Total Life Cycle Cost

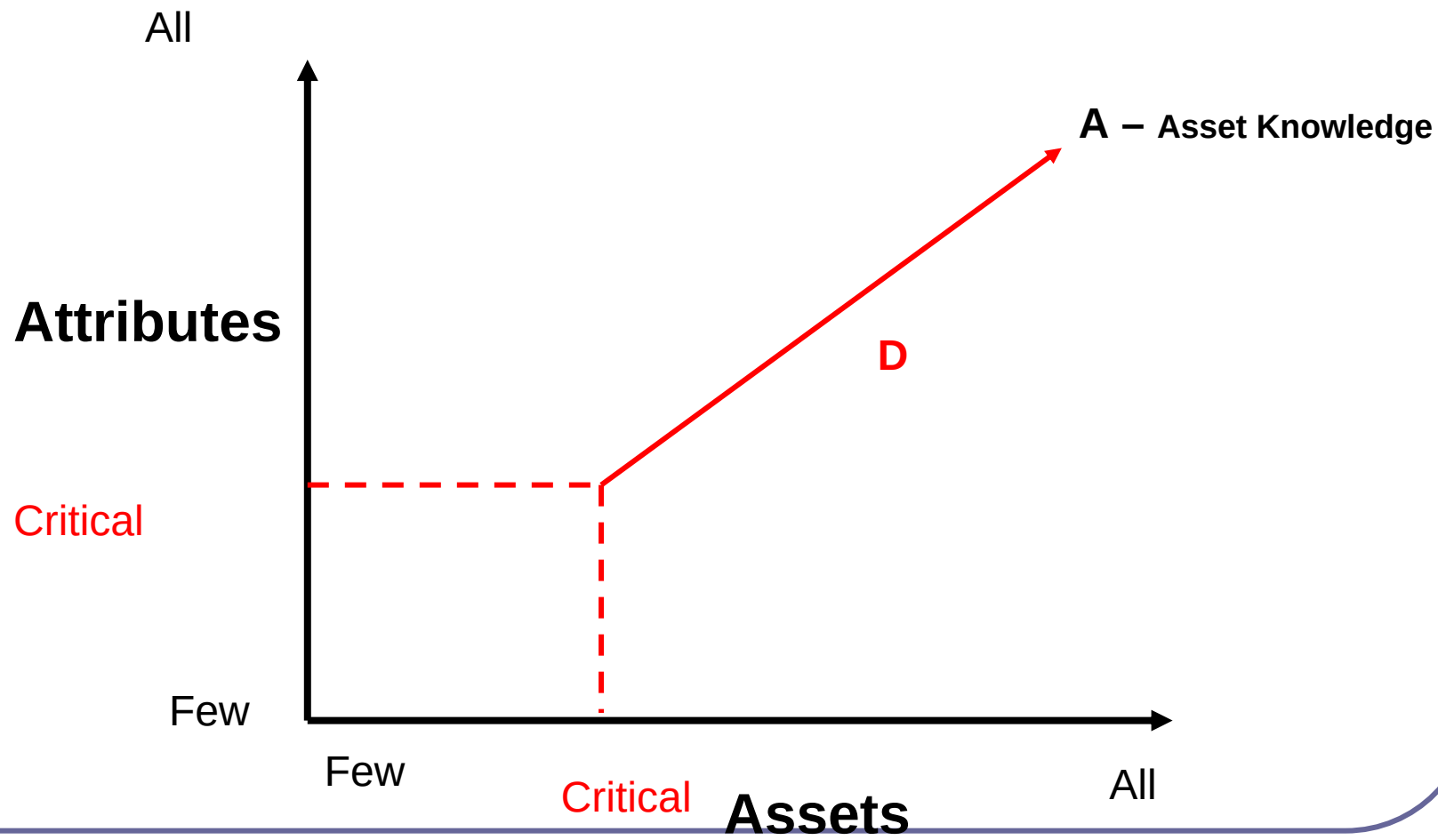


“A Dollar Spent is A Dollar Spent”

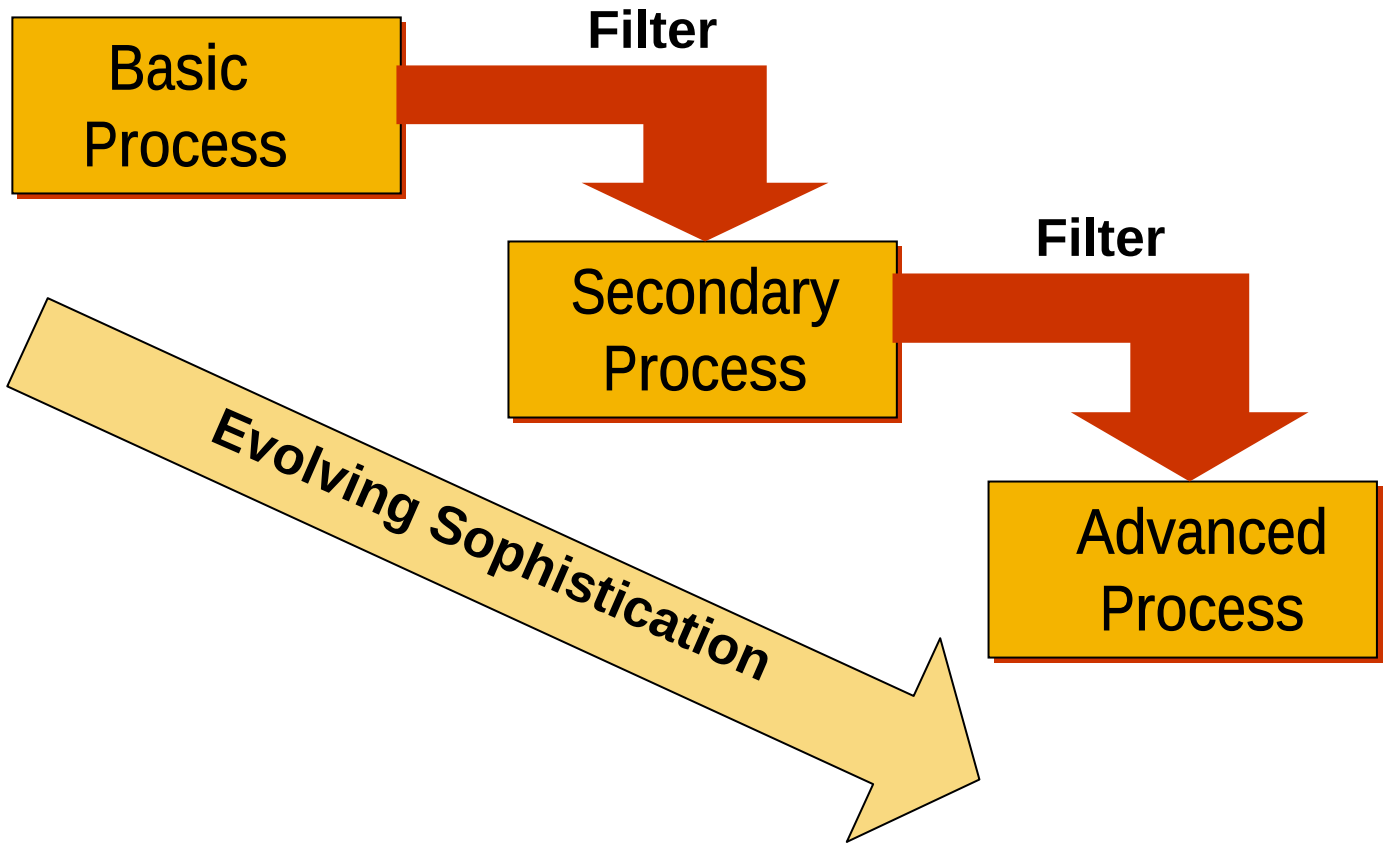
As A Sector We Have Failed To Adequately Respect the Value of Quality Information!

Best Appropriate Process + **Quality of Data Used** = **Confidence That the Course Is the Right One!**

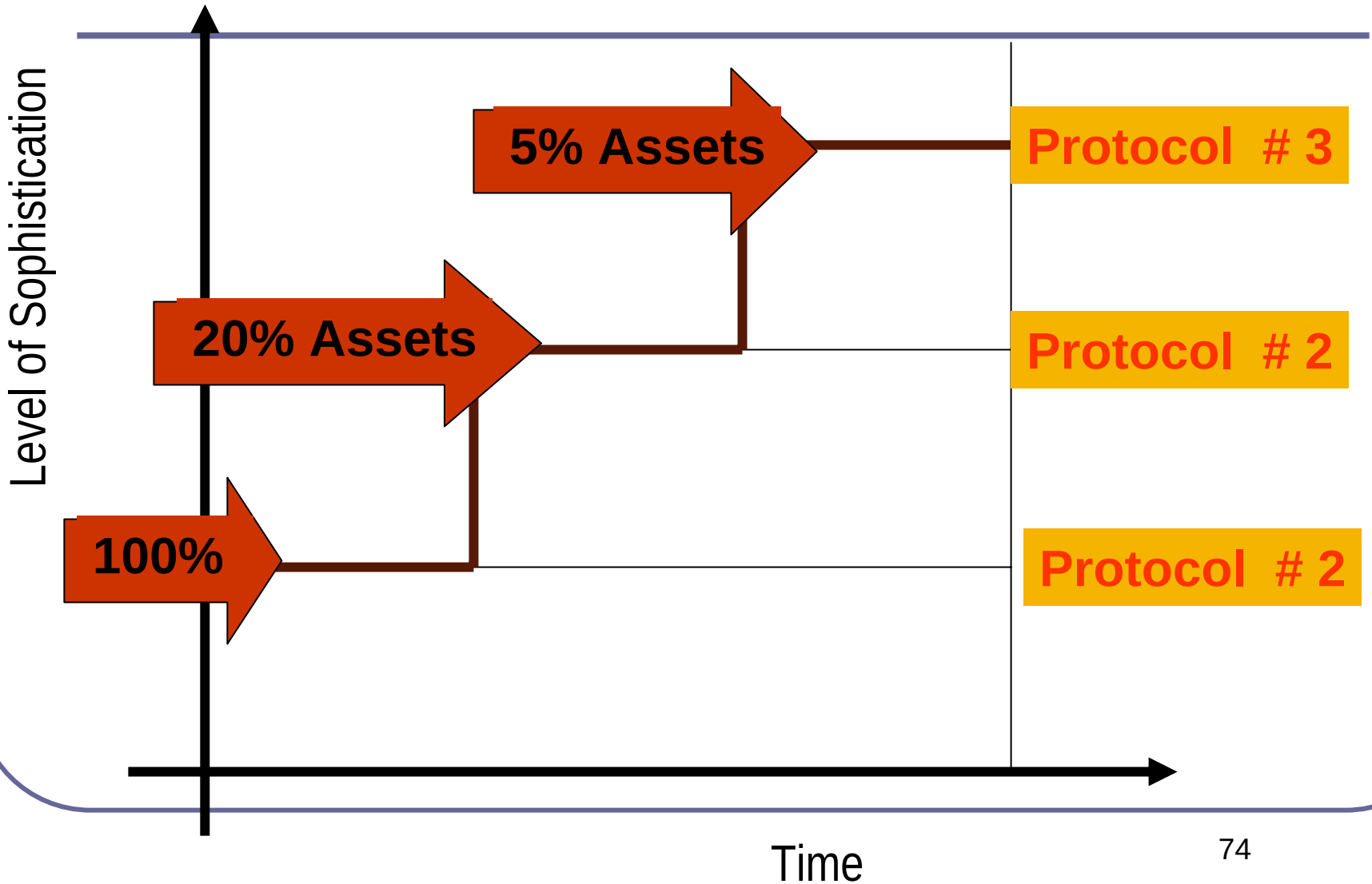
Effective Data Strategies Tie Back To Understanding What's Most Critical To the System



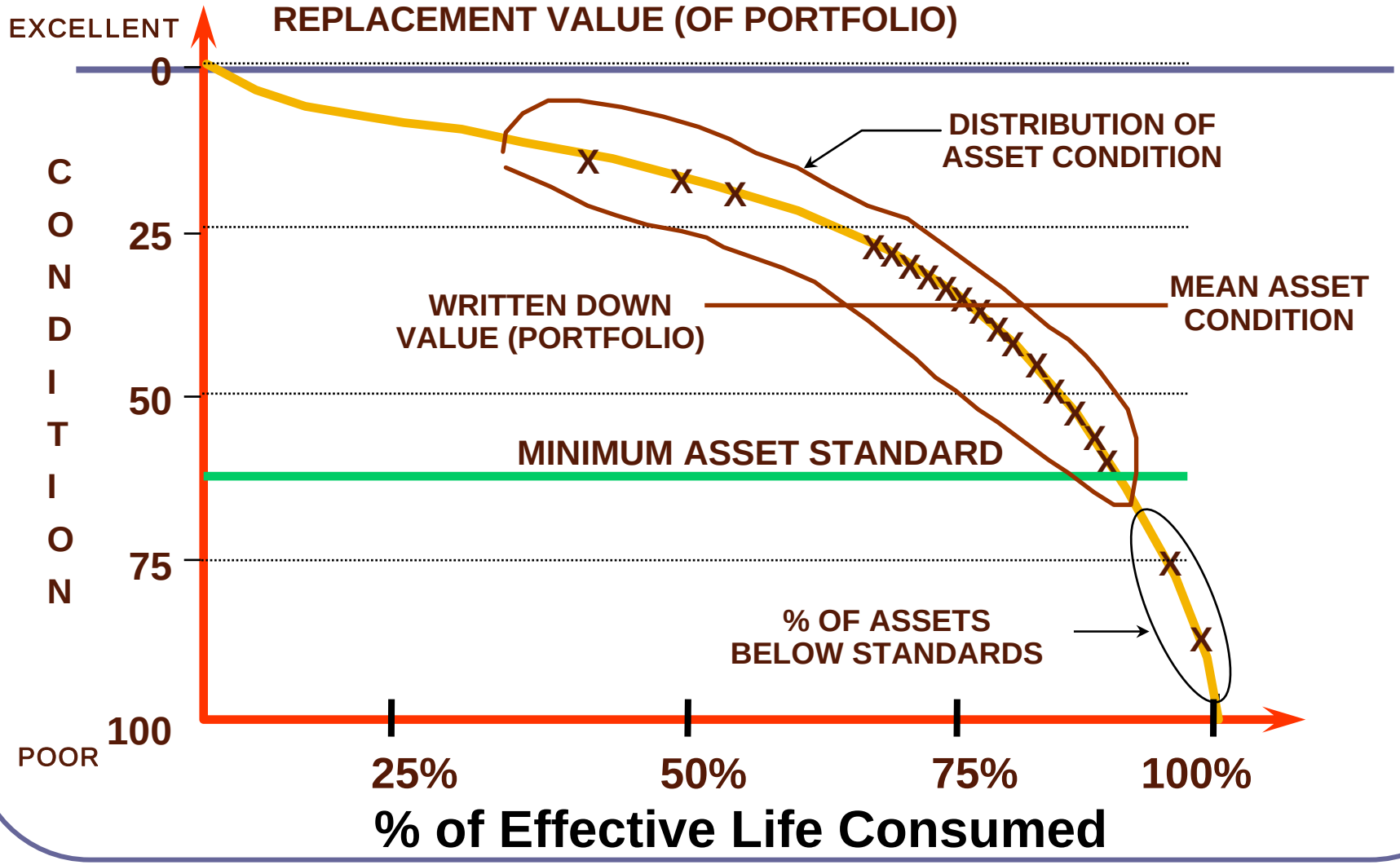
Everything Should Not Be Done With the Small Level of Emphasis – Use Filters To Focus Decision-Making



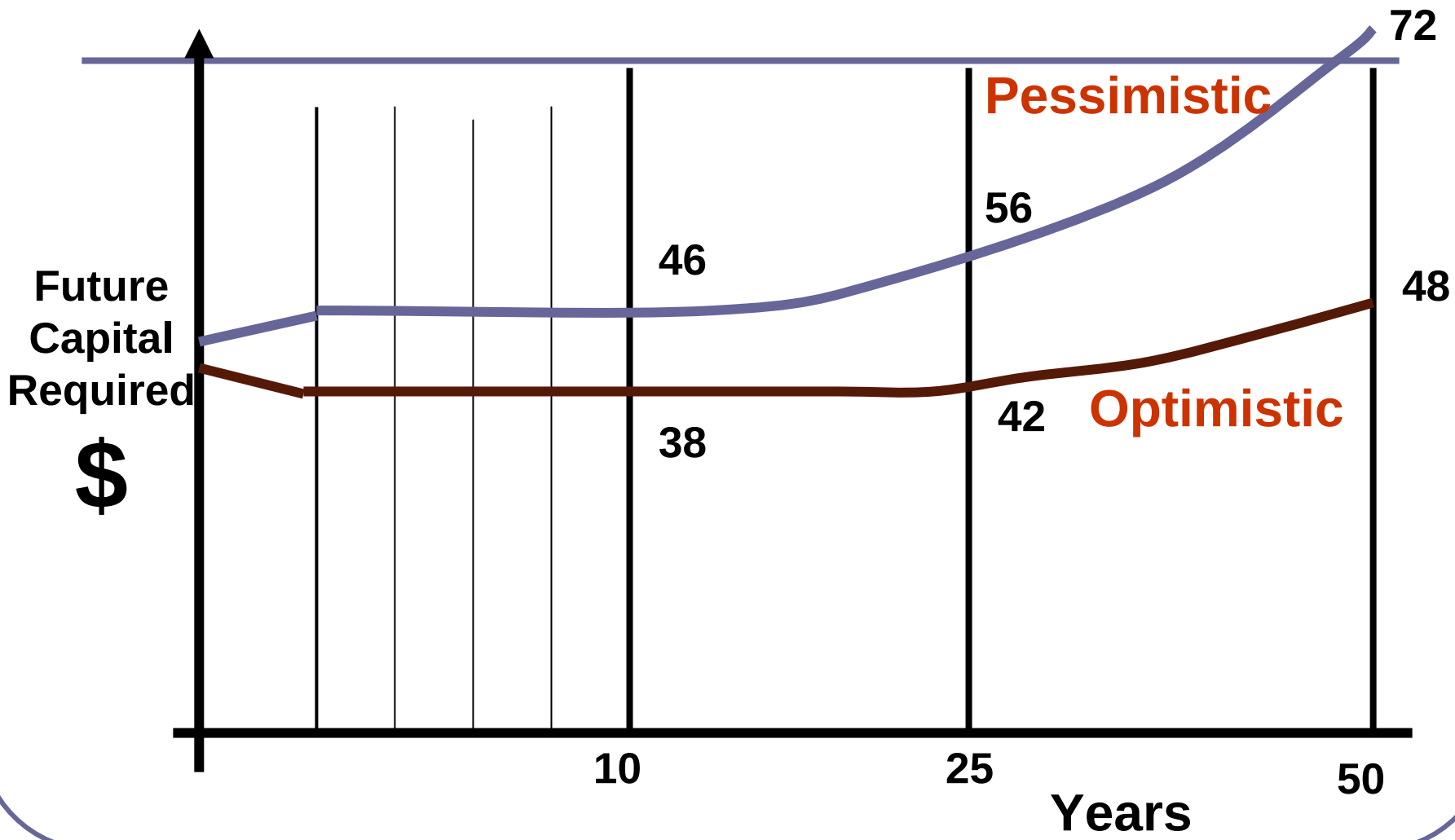
For Example: A Stepped Approach to Condition Assessment Protocols



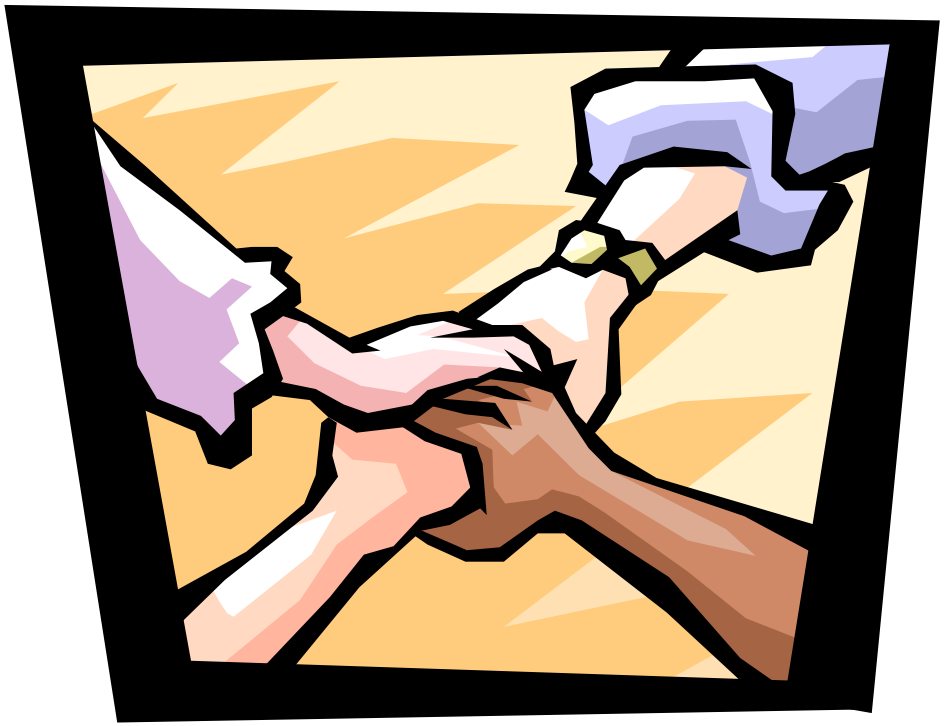
Apply The "% of Effective Life Consumed" Concept To the Whole of The Portfolio Of Assets



Build An Envelope Around the Financial Picture

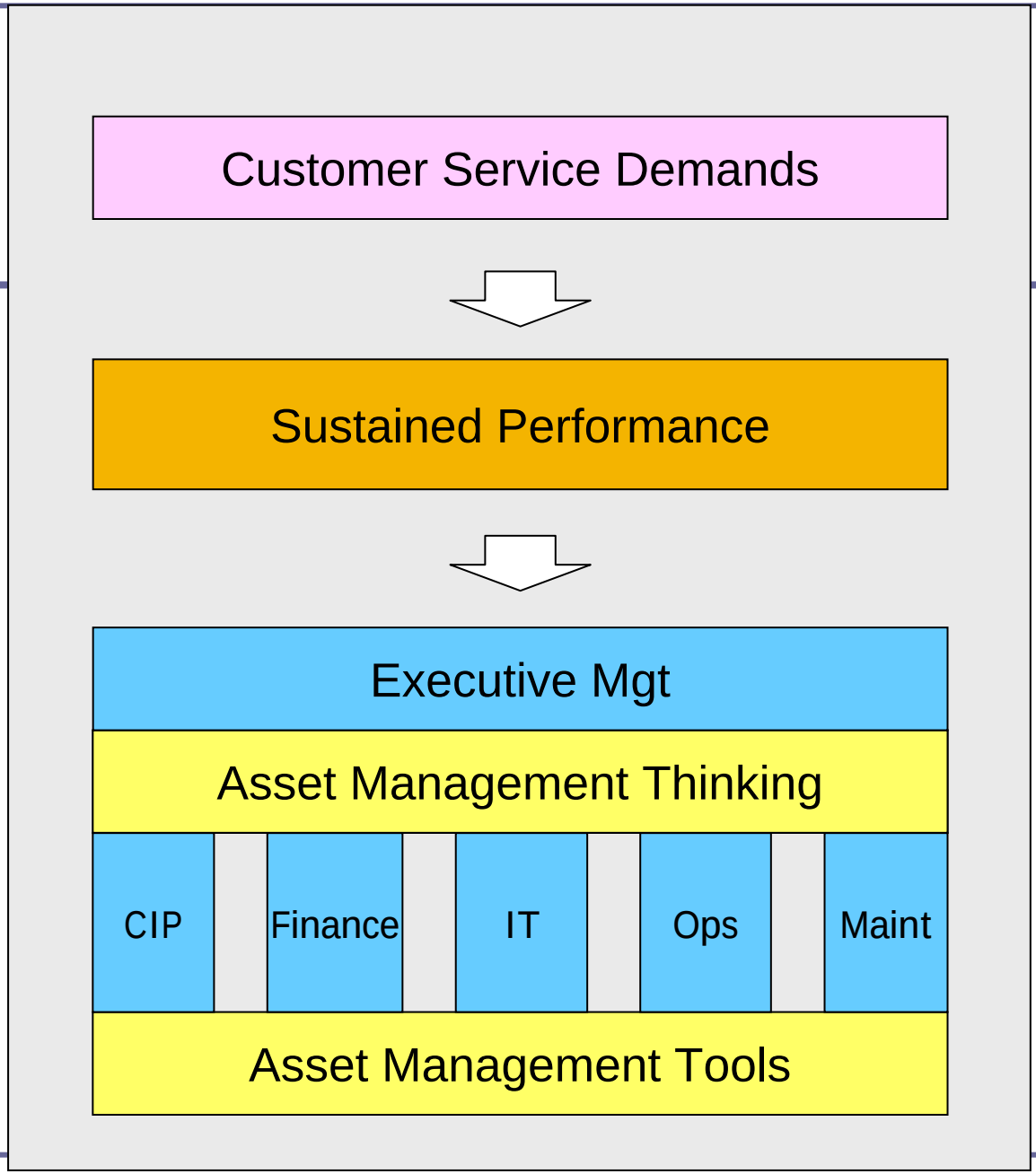


The Asset Management Challenge: Creating Cultural Change of Organizations



Asset Management Is Not Just For Engineering and O&M Anymore

Asset investment decisions are based on the needs of the WHOLE organization and the Customer



Breakdown The Silos With Asset Centric Thinking

Rolling the Ball Forward –

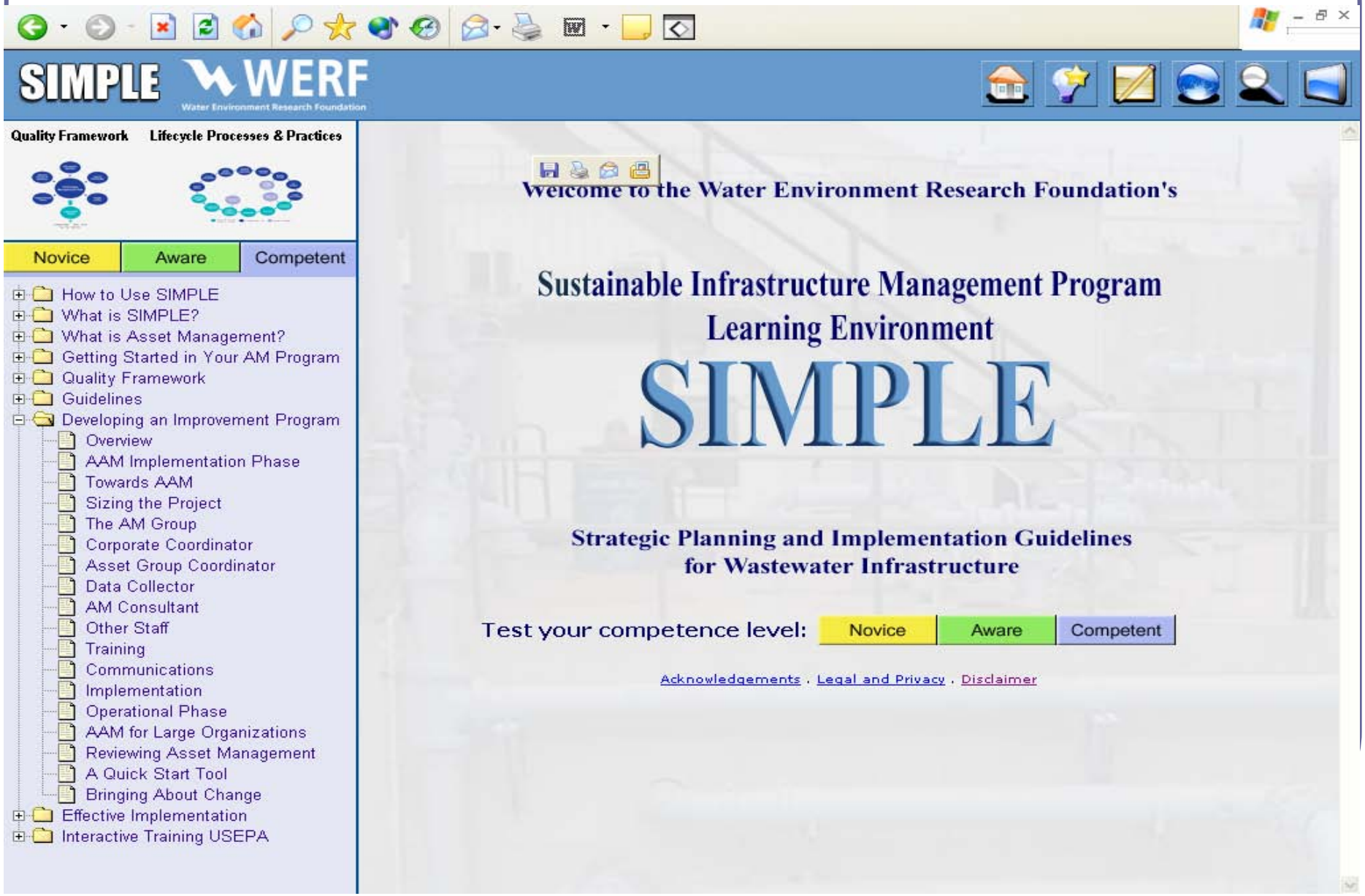
- A number of leading edge communities provide examples of how to take steps forward.
- SIMPLE
- NAMS
- The Collaborative Working Session
- WERF Condition Assessment Measures Matrices Project
- USEPA AAM workshops.

WERF's "SIMPLE" Project

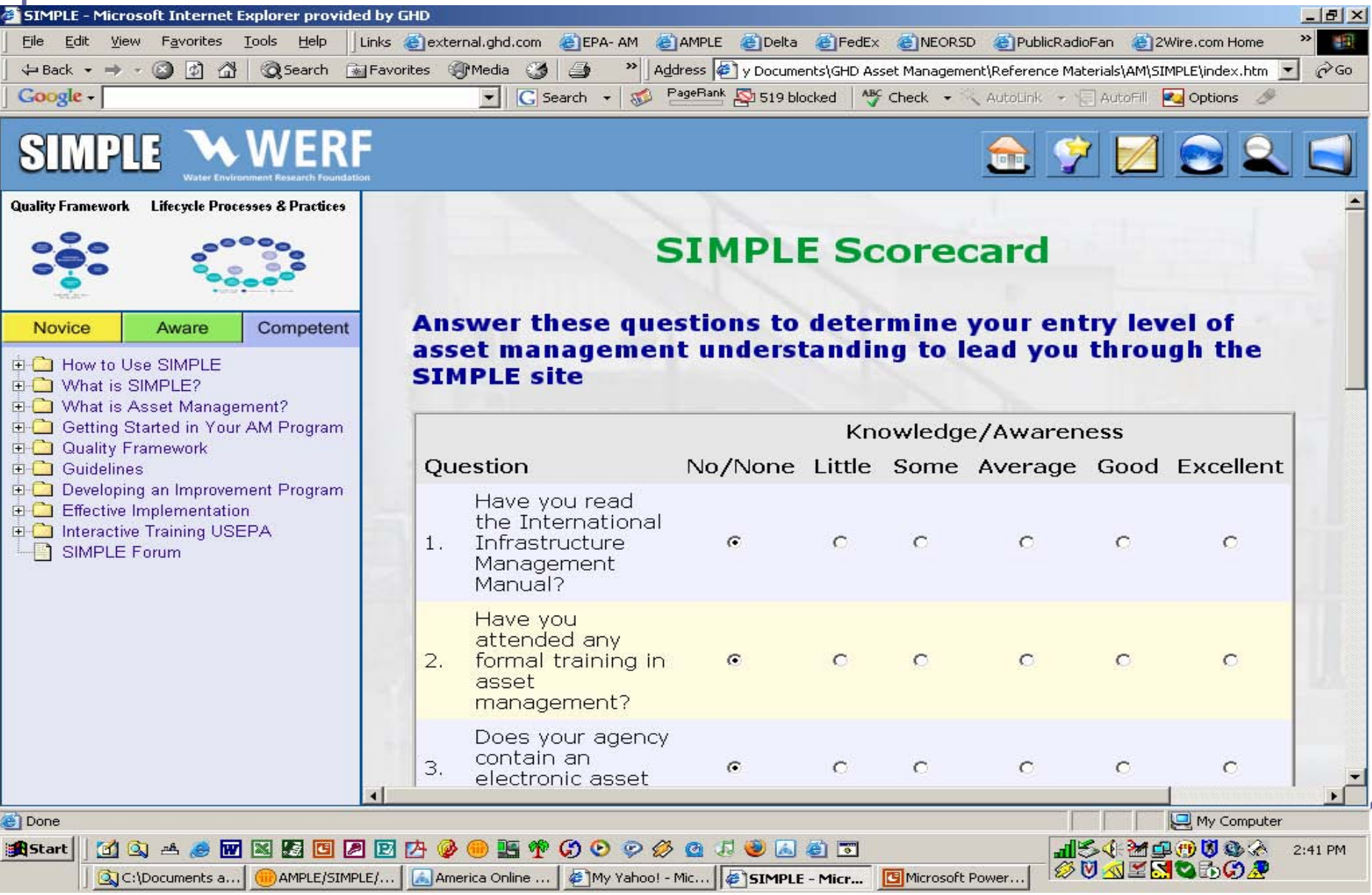
"Sustainable Infrastructure Management Program Learning Environment"

A Knowledge Management System

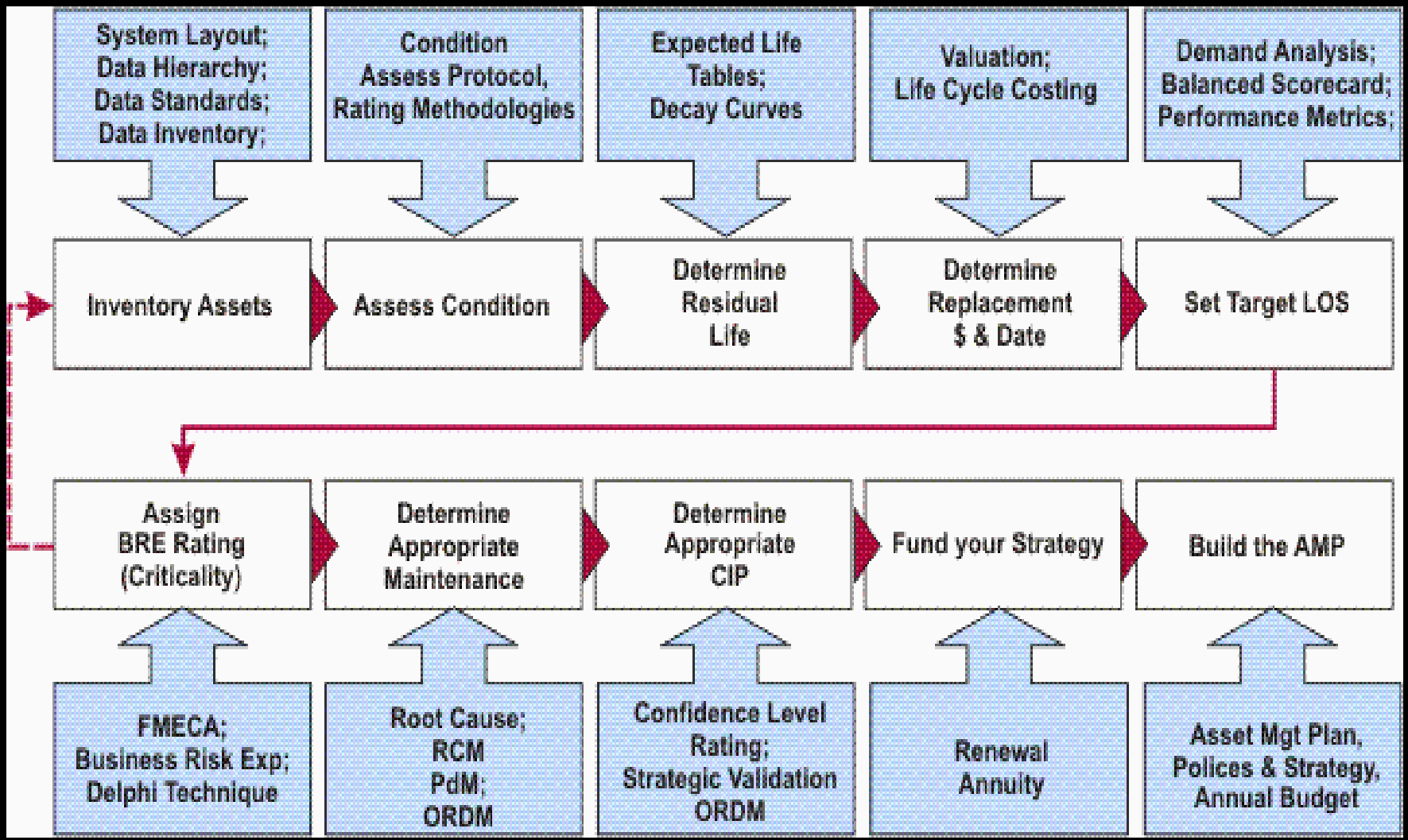
The Start-up Screen



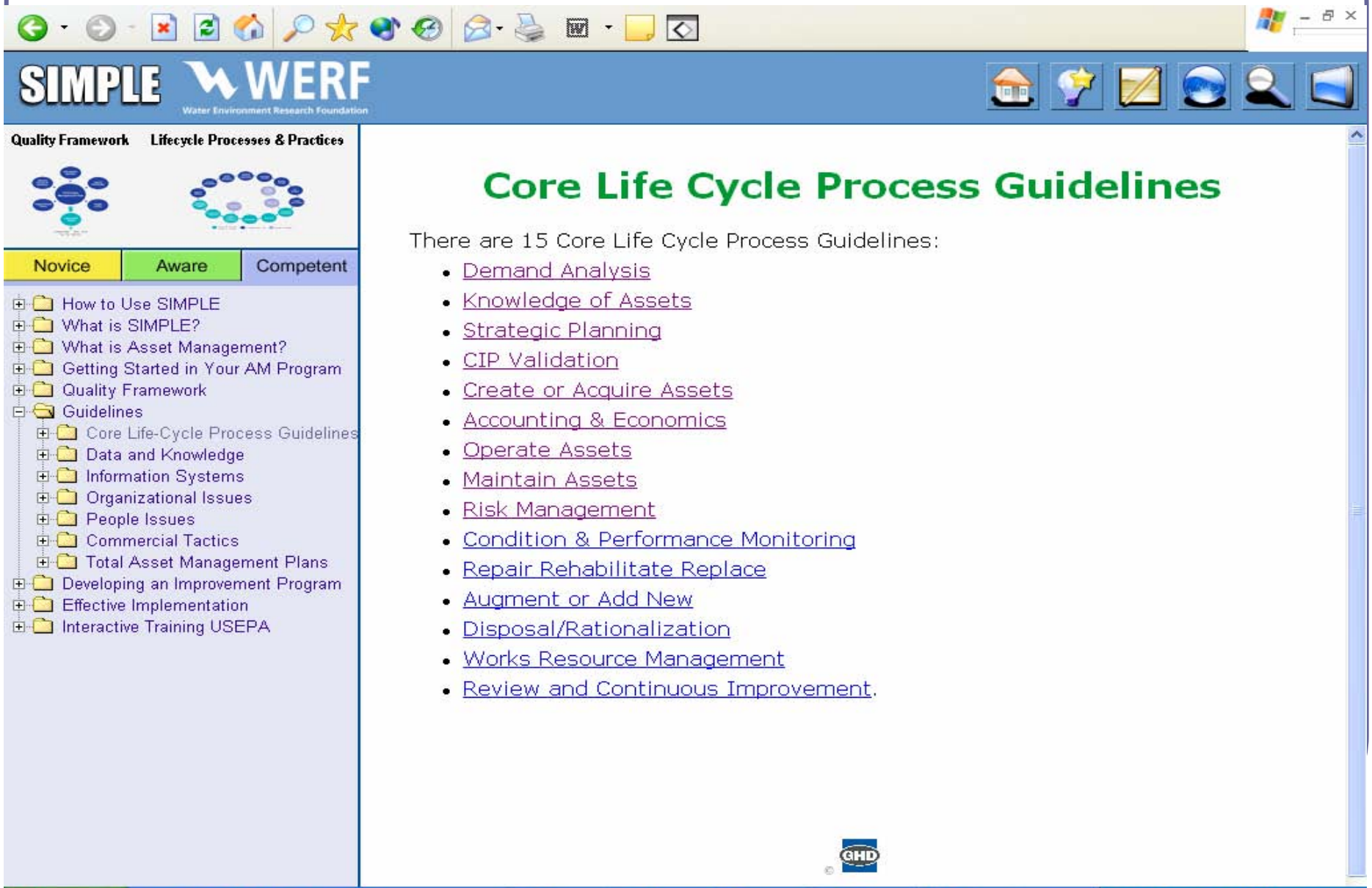
Level of User - Considered



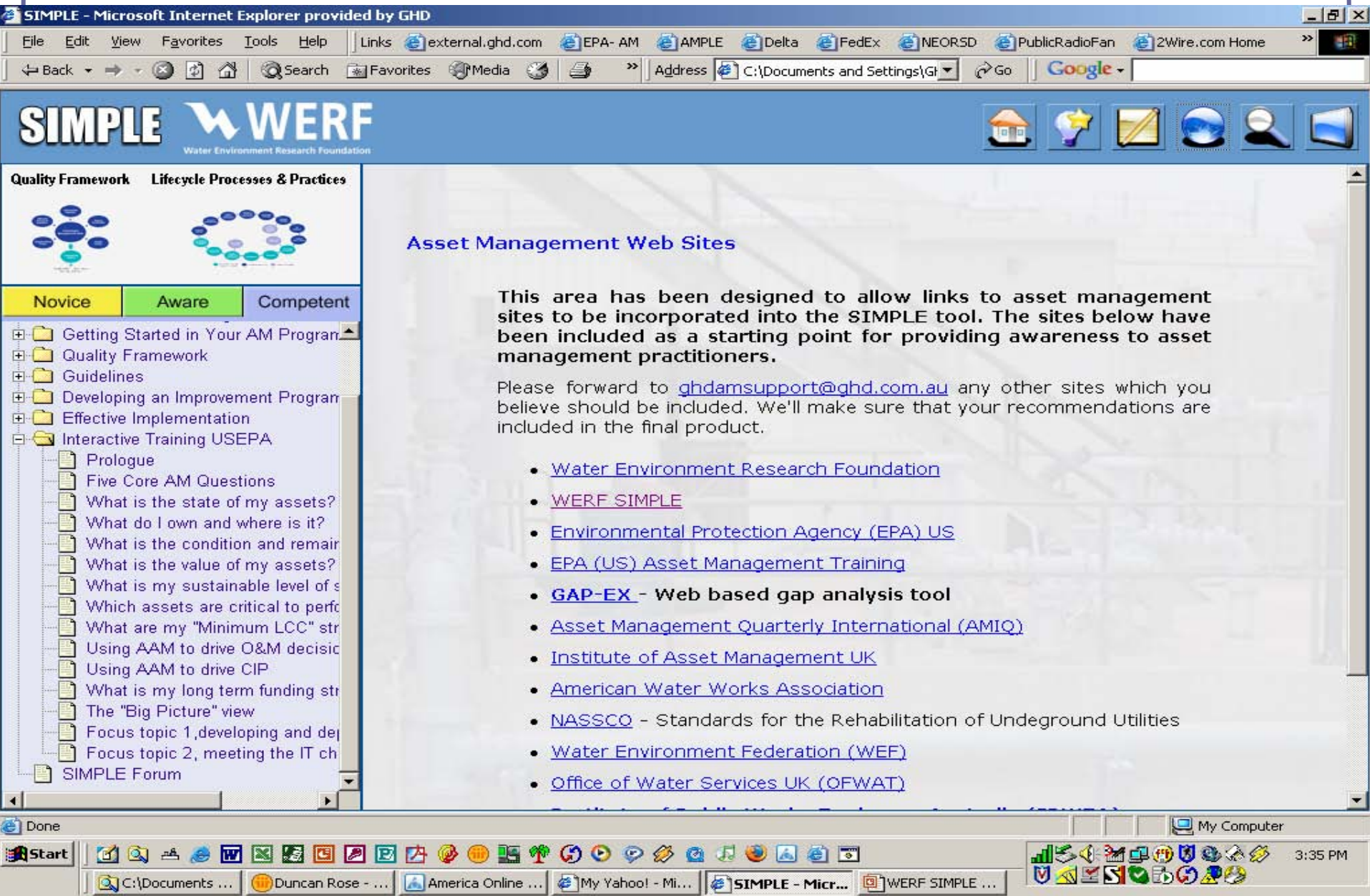
The "Core Processes and Practices" View Matches USEPA AAM Training



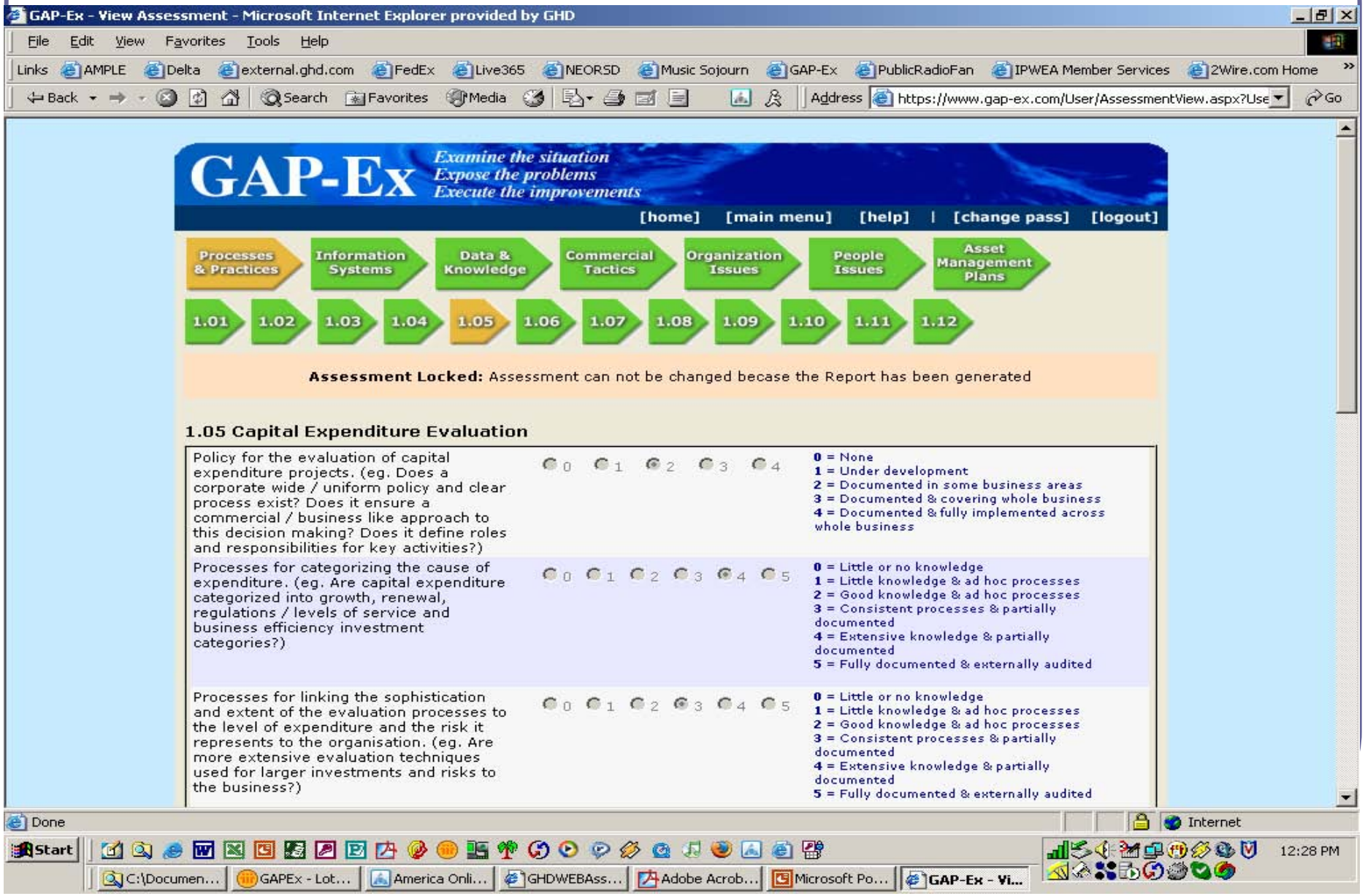
Core Life-Cycle Process Guidelines



Web Links & Distance Learning Capabilities



Self-Assessment "Gap" Analysis

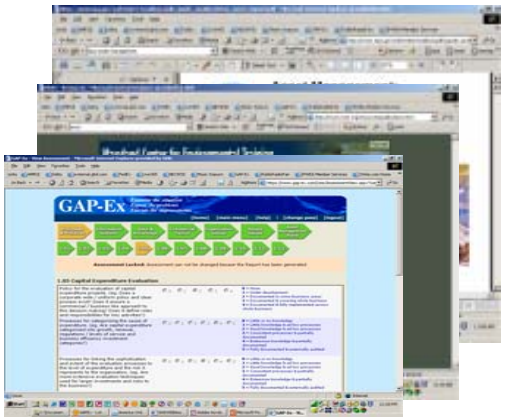


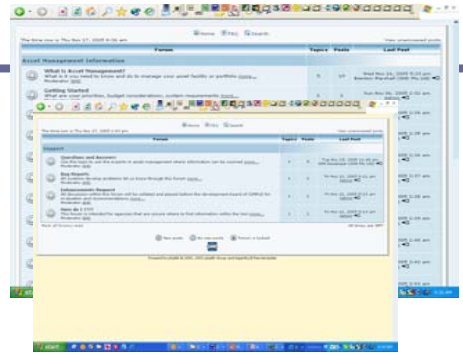
Where to From Here?

Discussions

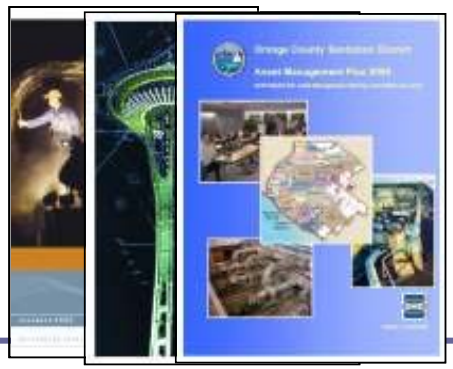
Research

Tools



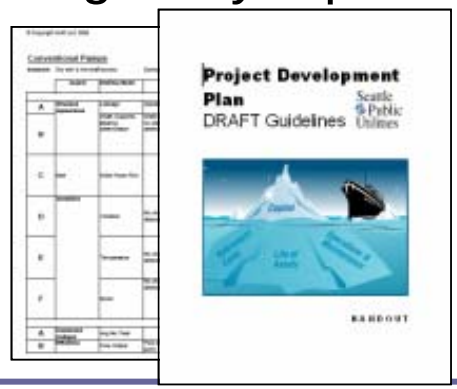


Examples/
Case Studies



Training
Accreditation
Qualifications

Agency Specific



TOTAL ELECTRONIC ASSET MANAGEMENT SYSTEM

TEAMS
Open Source Asset Management Software for Small Communities

United States Environmental Protection Agency (USEPA)

Maryland Center for Environmental Training (MCET)

Delaware Environmental Training Center (DelTech)

Pilot Program

- The bottom line:
  - Pilot asset management program at four small- to medium-sized wastewater utilities in Maryland and Delaware
  - Develop “user friendly” software - TEAMS
  - Develop training curriculum for national distribution

What Does the Future Hold For Utilities?

It’s All About Sustainability!

The Key Characteristics of Sustainable Utilities

Sustainable Systems Apply a Highly Developed Framework Of Existing Systems Strategies

- **Ecologically Sustainable Development**

  Using, conserving and enhancing the community's resources so that ecological processes, so that the quality of life for both present and future generations is increased.

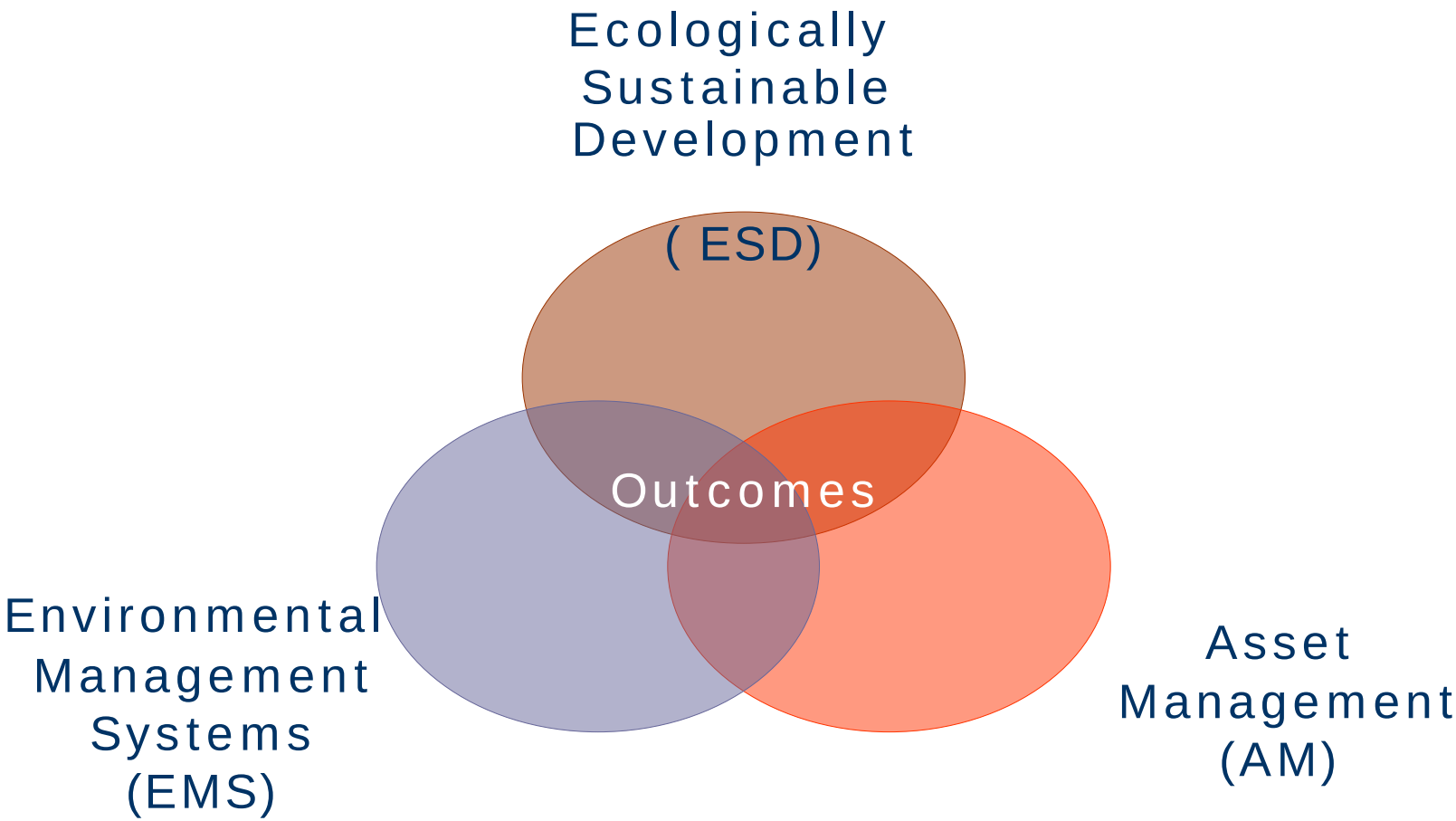
- **Environmental Management Systems**

  A structured set of policies, procedures, and practices to reduce an organization's environmental "footprint". Often used to integrate other utility management programs

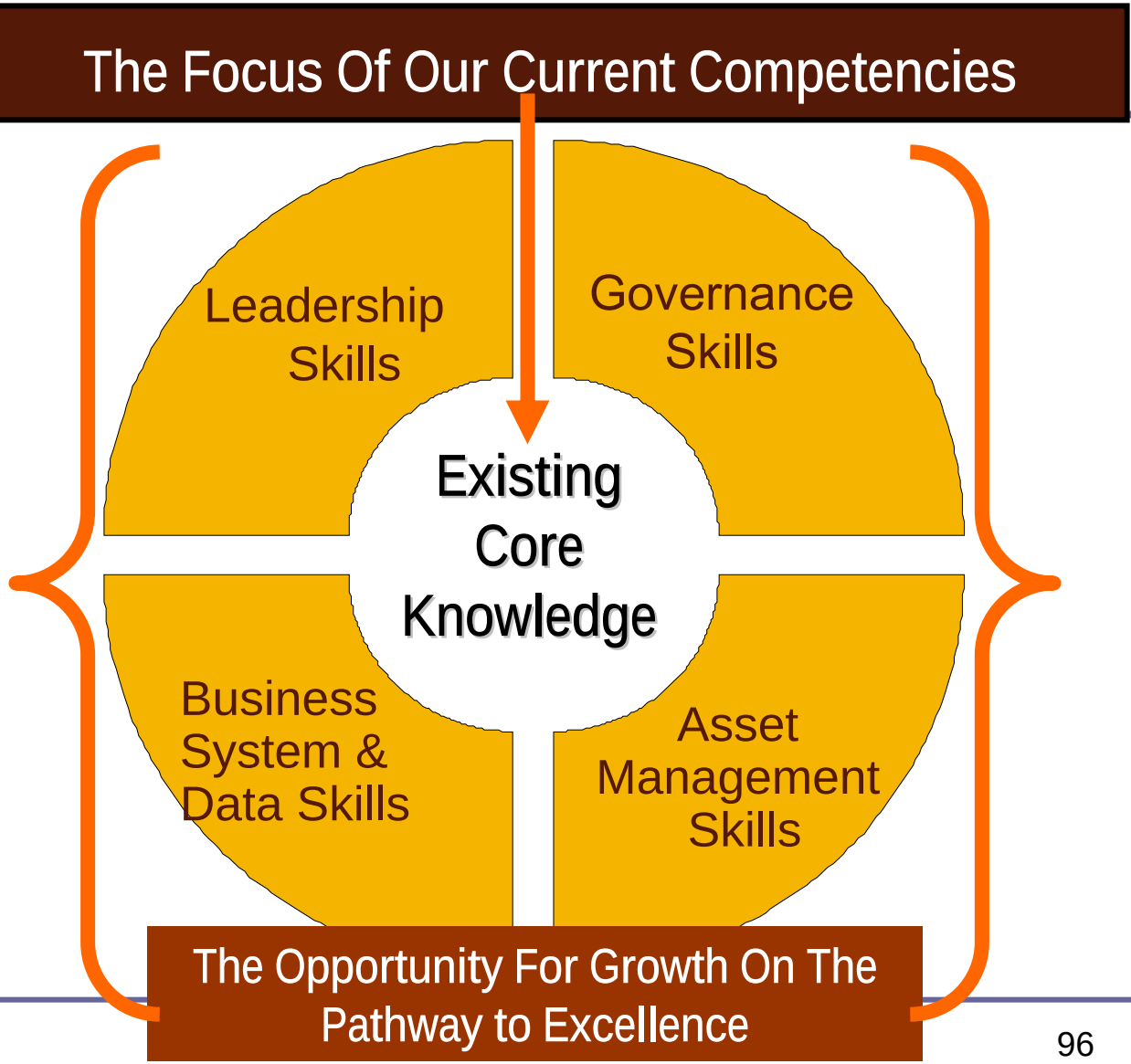
- **Strategic or Total Asset Management.**

  Managing assets to minimize the cost of owning and operating them while continuously delivering the desired or required customer service.

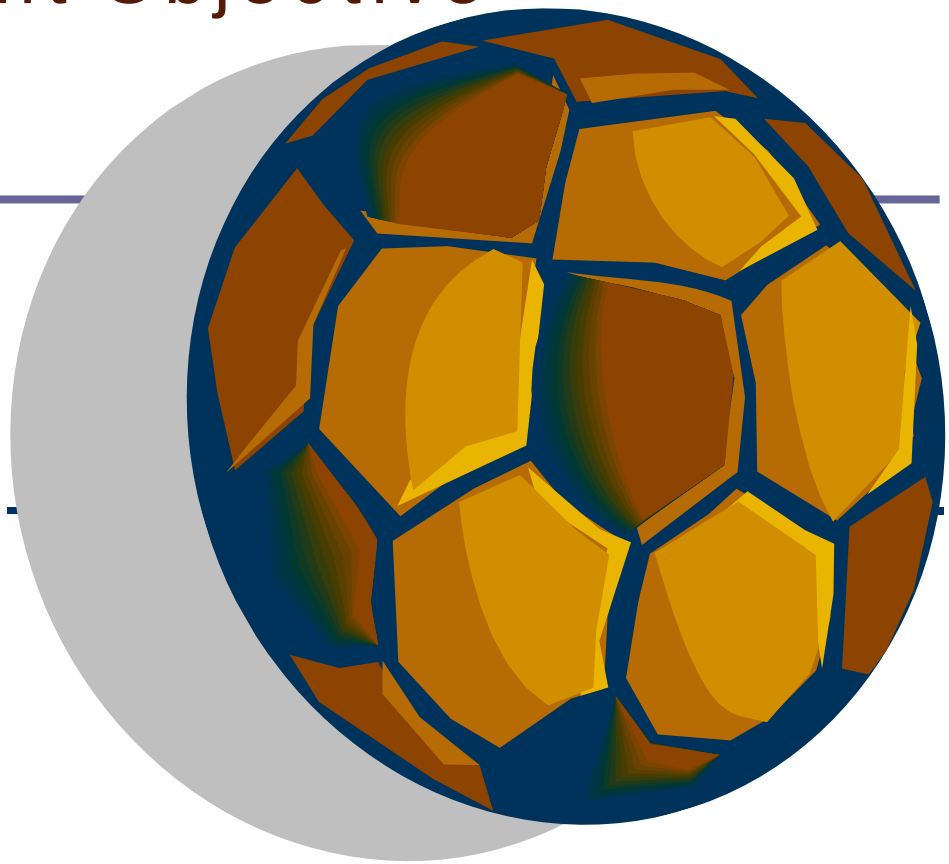
The Holistic View Of Sustainable Management Systems

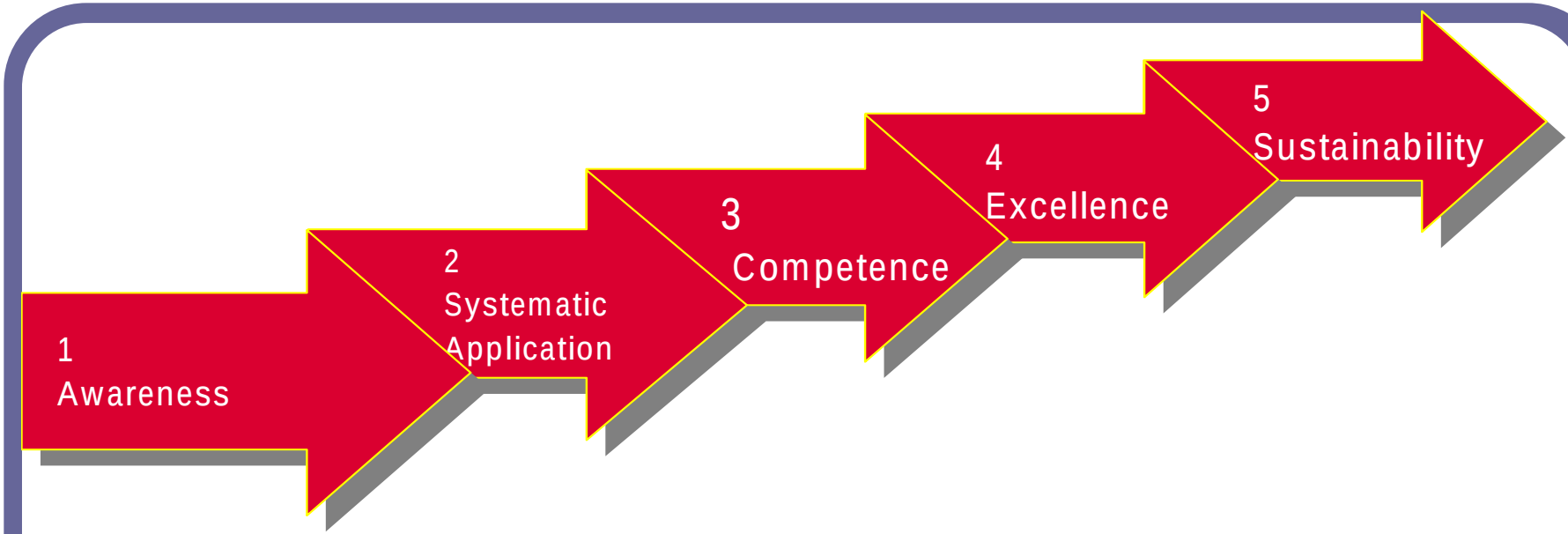


The Upcoming Focus - - Additional Skills Will Be Require to Become A Sustainable Business



Current Objective





The Pathway to Success In AAM
Is Through Adoption
of The Framework and Structure

Our Objective Is To Help You Develop Your Thinking About AAM and Provide A Solid Foundation For Taking Steps Forward In Applying The Framework.

- - Have A Great Two Days - -